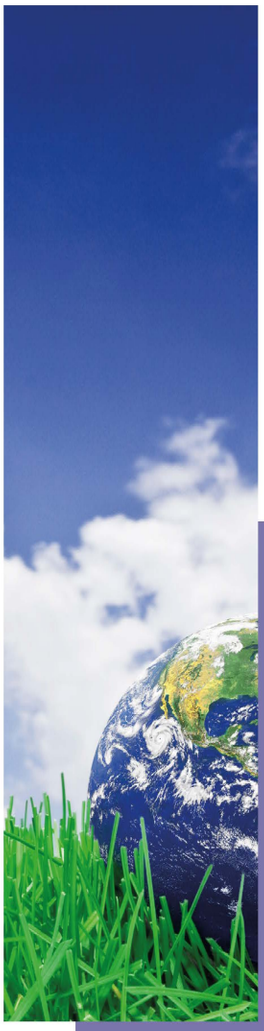
European Parliament

DIRECTORATE-GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A
ECONOMIC AND SCIENTIFIC POLICY



Economic and Monetary Affairs

Employment and Social Affairs

Environment, Public Health and Food Safety

Industry, Research and Energy

Internal Market and Consumer Protection

Legal obligations relating to emission measurements in the EU automotive sector

STUDY for the EMIS Committee

EN

2016

Legal obligations relating to emission measurements in the EU automotive sector

European Parliament

DIRECTORATE GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A: ECONOMIC AND SCIENTIFIC POLICY

Legal obligations relating to emission measurements in the EU automotive sector

STUDY

Abstract

This study looks at the discrepancy in NO_x emissions between type-approval tests and real-world driving. It examines the legal stakeholder obligations with regard to emission measurements in the European type-approval process and offers insights into the practical implementation of type-approval procedures throughout the EU.

This study was provided by Policy Department A at the request of the Committee of Inquiry into Emission Measurements in the Automotive Sector (EMIS).

IP/A/EMIS/2016-02 June 2016

PE 578.996 EN

This document was requested by the European Parliament's Committee on Emission measurements in the automotive sector.

AUTHOR(S)

Holger HEINFELLNER, Umweltbundesamt GmbH
Clemens KONRAD, Umweltbundesamt GmbH
Günther LICHTBLAU, Umweltbundesamt GmbH
Barbara SCHODL, Umweltbundesamt GmbH
Gudrun STRANNER, Umweltbundesamt GmbH
Ralf WINTER, Umweltbundesamt GmbH

RESPONSIBLE ADMINISTRATOR

Tina OHLIGER

EDITORIAL ASSISTANT

Mirari URIARTE

LINGUISTIC VERSIONS

Original: EN

ABOUT THE EDITOR

Policy departments provide in-house and external expertise to support EP committees and other parliamentary bodies in shaping legislation and exercising democratic scrutiny over EU internal policies.

To contact Policy Department A or to subscribe to its newsletter please write to:
Policy Department A: Economic and Scientific Policy
European Parliament
B-1047 Brussels
E-mail: Poldep-Economy-Science@ep.europa.eu

Manuscript completed in May 2016
© European Union, 2016

This document is available on the Internet at:
http://www.europarl.europa.eu/studies

DISCLAIMER

The opinions expressed in this document are the sole responsibility of the author and do not necessarily represent the official position of the European Parliament.

Reproduction and translation for non-commercial purposes are authorised, provided the source is acknowledged and the publisher is given prior notice and sent a copy.

CONTENTS

LIST OF ABBREVIATIONS 5

LIST OF BOXES 8

LIST OF FIGURES 8

LIST OF TABLES 8

EXECUTIVE SUMMARY 9

INTRODUCTION 13

1. LEGAL FRAMEWORK FOR EC TYPE APPROVAL AND VEHICLE EXHAUST EMISSION MEASUREMENTS 14

1.1. Directive 2007/46/EC (Framework Directive) 14

1.2. Regulation (EC) 715/2007 17

1.3. Regulation (EC) 692/2008 18

2. STAKEHOLDER OBLIGATIONS REGARDING EMISSION MEASUREMENTS IN THE TYPE-APPROVAL PROCESS 21

2.1. Obligations of the Member States 21

2.2. Obligations of the type-approval authorities 22

2.3. Obligations of the technical services 24

2.4. Obligations of the European Commission 24

2.5. Obligations of the original equipment manufacturers 25

3. OVERVIEW OF THE EU TYPE-APPROVAL PROCESS 28

3.1. Step 1: OEM's application for type approval & initial CoP assessment 29

3.2. Step 2: Testing process 30

3.3. Step 3: Submission of documents 31

3.4. Step 4: Granting of the ECWVTA & concluding CoP arrangements 31

3.5. Step 5: Vehicle registration & continued CoP verification 31

3.6. Step 6: In-service conformity (ISC) 31

4. INSIGHTS INTO THE PRACTICAL IMPLEMENTATION OF THE EU TYPE-APPROVAL PROCESS AT COUNTRY LEVEL 33

4.1. The OEM selecting the type-approval authority 35

4.2. The OEM selecting the technical service 38

4.3. Interaction between technical service and type-approval authority 39

4.4. Conformity of production 41

4.5. In-service conformity 41

5. STATUS-QUO OF PENALTY EXECUTION AT MS LEVEL 43

6. EMISSION MEASUREMENTS IN THE CONTEXT OF THE EU TYPE-APPROVAL PROCESS 45

6.1. The need for driving cycles 45

6.2. The NEDC and its original purpose 46

6.3. The need for a new driving cycle – WLTP 47

6.4. The need for a new test procedure – RDE 48

6.5. The need for independent measurement laboratories 49

6.6. Communicating the emissions discrepancy 52

7. CONCLUSION AND POLICY RECOMMENDATIONS 55

7.1. Stakeholder conclusions 55

7.2. Recommendations 57

REFERENCES 59

ANNEX 63

LIST OF ABBREVIATIONS

ACEA European Automobile Manufacturers Association

ADAC Allgemeiner Deutscher Automobil-Club
(German Automobile Club)

AECC Association for Emissions Control by Catalyst

ARTEMIS Assessment and Reliability of Transport Emission Models and Inventory Systems

BAV Bundesanstalt für Verkehr
(Austrian type-approval authority)

BMLFUW Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft
(Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management)

BMVIT Bundesministerium für Verkehr, Technologie und Innovation
(Austrian Ministry for Transport, Innovation and Technology)

CADC Common Artemis Driving Cycle

CNRV Centre National de Réception des Véhicules
(French type-approval authority)

CoC Certificate of Conformity

CoP Conformity of Production

COPERT COmputer Program to calculate Emissions from Road Transport

CORINAIR CORe INventory AIR emissions

DEKRA Deutscher Kraftfahrzeug-Überwachungs-Verein
(German Technical Service)

DIN Deutsches Institut für Normung
(German standardization institute)

DG Directorate-General

EC	European Commission
ECWVTAC	European Commission Whole Vehicle Type-Approval Certificate
EEA	European Environment Agency
EMEP	European Monitoring and Evaluation Programme
EN	European Norm
ERMES	European Research for Mobile Emission Sources
EU	European Union
EURO	European emission standards
GRPE	Working Party on Pollution and Energy (UNECE)
HBEFA	Handbook Emission Factors for Road Transport
ICCT	International Council on Clean Transportation
IES	Institute for Environment and Sustainability
IET	Institute for Energy and Transport
ISC	In-Service Conformity
ISO / IEC	International Organization for Standardization
JRC	Joint Research Centre (of the European Commission)
KBA	Kraftfahrt-Bundesamt Deutschland (German type-approval authority)
M_1	Vehicles used for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat (passenger cars)
M_2	Vehicles used for the carriage of passengers, comprising more than eight seats in addition to the driver's seat, and having a maximum mass not exceeding 5 tonnes (bus)
MVEG	Motor Vehicle Emission Group

MS	EU Member State
N_1	Vehicles used for the carriage of goods and having a maximum mass not exceeding 3.5 tonnes (pick-up truck)
NEDC	New European Driving Cycle
NO_x	Nitrogen Oxide
NTE	Not-To-Exceed
OBD	On-Board-Diagnostics
OEM	Original Equipment Manufacturer, here the car manufacturer
PEMS	Portable Emission Measurement System
RDE	Real Driving Emissions
RDW	Rijksdienst voor het Wegverkeer (Dutch type-approval authority and technical service)
T&E	European Federation for Transport and Environment
TCMV	Technical Committee on Motor Vehicles
TU Graz	Graz University of Technology
TÜV	Technischer Überwachungsverein (Association for Technical Inspection)
UNECE	United Nations Economic Commission for Europe
UTAC	Union technique de l'automobile, du motorcycle et du cycle
CERAM	Centre d'Essais et de Recherche Appliqué à la Mobilité (French technical service)
VCA	Vehicle Certification Agency (British type-approval authority and technical service)
WLTC	Worldwide Harmonized Light Vehicle Test Cycle
WLTP	Worldwide Harmonized Light Vehicle Test Procedure
WP.29	UNECE World Forum for Harmonization of Vehicle Regulations

LIST OF BOXES

Box 1: Status of RDE implementation 49
Box 2: Prospects of recent RDE legislation 49
Box 3: The history of HBEFA 50
Box 4: Communication between the EC and the MS based on the example of Austria 52
Box 5: Communication between the EC and independent laboratories/NGOs 52

LIST OF FIGURES

Figure 1: EU type-approval process 29
Figure 2: Type approval distribution by OEM in 2014 (1) 37
Figure 3: Type approval distribution by OEM in 2014 (2) 37
Figure 4: Number of technical services per type-approval authority 39
Figure 5: Shares of passenger car production and granted type approvals per EU MS in 2014 41
Figure 6: NEDC according to 70/220/EC 47
Figure 7: Comparing type approval emission regulations and air quality standards 51

LIST OF TABLES

Table 1: Obligations of the MSs according to the legislation 21
Table 2: Obligations of the type-approval authorities according to the legislation 22
Table 3: Obligations of the technical services according to the legislation 24
Table 4: Obligations of the EC according to the legislation 24
Table 5: Obligations of OEMs according to the legislation 25
Table 6: Consulted stakeholders 33
Table 8: Differences between NEDC and the WLTP test cycle 48

EXECUTIVE SUMMARY

Background

To obtain type approval and ensure registration in the European Union (EU), new vehicles must comply with emission standards (termed EURO classes). "Type" designates a category of vehicles that share specific characteristics and may be grouped together for testing and certification purposes. As it is rather impractical to test every single vehicle, "type approval" is a procedure where one car is tested and certified for all other vehicles in its category. As part of the procedure, all light-duty vehicles need to be tested on what is known as a chassis dynamometer[1]or roller bench. "Approval" is up-front third party verification granted by a national type-approval authority before the vehicle type may be placed on the market. New passenger cars have had to pass an emission test known as the New European Driving Cycle (NEDC) in order to obtain type approval for the European market since the 1990s. The NEDC dates back to the late 1960s and was originally not intended to reflect real-world driving performance. As a result, a growing discrepancy has emerged between the outcome of the emissions test in the type-approval process and the actual emissions that occur. As the emissions produced by EURO 5 and 6 diesel vehicles in real driving conditions on the road vastly exceed the emissions measured in the regulatory NEDC, the EC set up a working group comprising all interested stakeholders in January 2011 with the aim of developing a Real Driving Emissions (RDE) test procedure that better reflects the emissions measured on the road. This growing discrepancy has likewise stepped up the need for re-measurement by independent emission testing laboratories. Thus, two separate "worlds" have emerged over the years - one where emission limits need to be met in the NEDC and which forms part of the type-approval process, and a second one where national emission inventories base their emission models and calculations on real-world emission factors developed by an EU-wide community of independent research and testing laboratories.

Purpose

On the one hand, the purpose of this study is to describe the legal obligations of the different stakeholders involved in the type-approval process, especially in emission testing. On the other hand, the study offers insights into the practical implementation of the EU type-approval process throughout the EU.

Key findings

The following key findings have been identified:

- Overall, the legal framework consists of a host of individual regulatory acts linked by a vast number of cross-references. This framework is very complex, which makes it difficult to see the whole picture. Furthermore, the legal requirements lack clarity and precision in many ways. Only expert teams, mainly from Original Equipment Manufacturers (OEMs) or technical services are able to gain an overall perspective of the regulation and its practical implementation.

[1] A chassis dynamometer is designed to operate a vehicle indoors on a stationary platform to simulate real-world vehicle operation. The vehicle is driven on rollers, following a predefined driving pattern, with the dynamometer simulating the vehicle's inertia as well as the air drag resistance and friction on the vehicle (known as "road load").

- There is a lack of consistency in the penalties at MS level in the EU. The EU needs to further adjust the penalty provisions for the MSs.
- So far, no cases are known within the EU where OEMs have been sanctioned because of infringements listed in (EC) Regulation No 715/2007 (Art. 13).

Regarding the structure of the type approval system and the relationships between OEMs, technical services and type-approval authorities, many practical developments need to be critically examined:

- OEMs get to choose from 28 different type-approval authorities and more than 300 technical services. Commercial relationships may give rise to conflicts of interest.
- Type-approval authorities do not have the standard expertise and the necessary funds. Moreover, interaction between type-approval authorities and technical services is hampered by a lack of harmonisation and specification. As a consequence, type-approval process quality standards vary throughout the EU.
- In some cases, the technical services responsible for testing or supervising tests at the facilities of OEMs are partly owned by the OEMs or integrated into a national type-approval authority. Moreover, some technical services offer research and development services. There is an obvious lack of separation of powers.
- The verification of In-Service Conformity (ISC) testing for passenger cars is based on laboratory tests by the OEM himself. There is no legal basis for mandatory testing under real-world driving conditions by an independent third party.
- In the event of non-conformity, MSs that did not issue the underlying type approval are unable to take proper action in the current legal framework, which also represents an impediment to voluntary market surveillance programmes as these are usually financed by the MSs.

A number of weaknesses in emission measurement are already known, including the NEDC's inability to represent real-world driving emissions. The key findings are:

- Because the subject matter is highly complex, many measurement regulations are specified or heavily influenced by industry players.
- The requirements regarding boundary test conditions and the vehicle setup in the NEDC are defined in a manner that optimises the performance of vehicles in the test bench tests conducted by the OEMs. The conventional testing methods used in the type-approval process are unable to detect illegal defeat devices. Type approval emission values are not representative for the emissions produced by modern vehicles in real-world driving conditions.
- Therefore, the Handbook Emission Factors for Road Transport (HBEFA) established measurement programmes over the past 20 years.[2]

[2] The HBEFA group provides real-world emission factors for the most common vehicle types - differentiated by emission concepts and traffic situations for pollutants, fuel consumption and CO2 – which were measured using other more realistic test cycles than the NEDC. These programmes are funded by HBEFA member countries in a bid to support the MSs with real-world emission data for road transport. No EU money has been involved except in the ARTEMIS project (Assessment and Reliability of Transport Emission Models and Inventory Systems) which covered the period from 2002 to 2007 and was funded by the EC as part of the 5th Framework Research Programme.

- Starting in 2017, the new Worldwide Harmonized Light Vehicle Test Cycle (WLTC) should predict exhaust emissions and fuel consumption under real-world driving conditions more accurately.
- Going by the current negotiation status, around 95 % of all driving conditions will be covered during RDE testing.
- To ensure that the vehicles are subject to all the relevant driving conditions, ISC measurements by independent laboratories are of crucial importance.

Recommendations

- **Streamlining existing legislation and regulations.**
  - To provide a clear structure with well-defined responsibilities for the MSs, type-approval authorities, OEMs and technical services with specific competences.
  - To support and strengthen the exchange of knowledge regarding standards and implementation of the relevant legislation between type-approval authorities in a bid to harmonise the type-approval process.
  - Technical services could be commissioned by the type-approval authorities, not by the OEMs, to reduce the conflict of interest arising from the commercial relationship. Preference should be given to category A technical services with their own testing facilities and related experience.
- **Switching from the NEDC to the WLTP test cycle.**
  - From 2017 onwards, the Worldwide Harmonized Light Vehicle Test Procedure (WLTP) will be mandatory for emission testing. The most important part in the procedure will be the RDE test.[3] It is crucial to clearly specify and provide adequate definitions of the boundary conditions in the emission test that represent real-world driving conditions in the EU.
  - Conformity factors for emission limits have been introduced to allow vehicles to emit higher emissions in real-world driving situations.[4] These conformity factors should be eliminated over time as existing technology already has the ability to reduce emissions to the emission limits in nearly all driving situations and boundary conditions.
- **Performing ISC tests organised and prepared by independent bodies and test laboratories.**
  - To have vehicle emissions re-tested by independent organisations, such as environmental agencies and independent laboratories, using PEMS in real driving boundary conditions that are representative for normal vehicle use in Europe.

[3] The RDE test includes what are termed Not-To-Exceed (NTE) limits. Therefore, a conformity factor is used as a multiplier by which the originally agreed EURO 6 limits are allowed to be exceeded.

[4] The WLTP "requires the real driving emissions from cars and vans to be lower than the legal limits multiplied by a 'conformity factor'. This factor expresses the ratio of on-road PEMS emissions to the legal limits. At the time of writing, the NOx conformity factor has been set to 2.1 (i.e. 110 % above the EURO 6 limit) from 1 September 2017 for new models and two years later for all new vehicles. In a second step, it will be reduced to 1.5 (i.e. 50 % above the EURO 6 limit) from 1 January 2020 for new models and one year later for all new vehicles." See EEA (2016c)

  - To ensure funding through a small registration fee in a bid to finance ISC in a manner that guarantees representative emission testing for the European vehicle fleet.
  - To have the OEMs publish the test results for vehicles as well as vehicle test settings.
- **Imposing clear sanctions on OEMs that fail to comply with emission legislation at EU level.**

Independent ISC re-testing and the publication of the results, in particular, will give rise to a situation where OEMs are keen to ensure the proper functioning of emission abatement systems under real driving conditions. As a result, OEMs will strive to optimise their exhaust gas systems on the basis of real driving conditions and not in emission test situations on test benches.

Moreover, the situation described above will reduce the need of MSs and type-approval authorities to acquire substantial technical experience and to finance this capacity-building effort, which is very cost-intensive, especially in the automotive sector, which is characterised by rapid technical development and change.

INTRODUCTION

This study focuses on the EU type-approval process for passenger cars (described in chapter 3). In EU MSs, vehicles may only be used once they have been given official authorisation. What is known as the EU type-approval Framework Directive 2007/46/EC is applicable for passenger cars and light commercial vehicles. This Directive consists of many detailed individual specifications and regulatory acts for the different technical systems and parts of the vehicle. Regulation (EC) No. 715/2007 and Implementing Regulation (EC) No. 692/2008 sets forth requirements for exhaust emissions. Chapter 1 describes the legal framework for type approvals. The legal instrument further specifies the obligations of the different stakeholders in the type-approval process, which are listed in chapter 2.

Chapter 4 offers insights into the practical implementation of the EU type-approval process at MS level. Chapter 5 describes the measures taken by the MSs to sanction infringements in this regard.

In terms of emission testing, the EC has proposed a major revision of the Framework Directive[5] with a view to ensuring more independent vehicle testing and increasing the surveillance of passenger cars already in circulation.[6] Chapter 6 gives more insights into the technical nature of emission measurements during the type-approval process and elucidates the underlying problem of the NEDC and its recent advancements (WLTP test cycle and RDE testing). Furthermore, the role of independent measurement laboratories, especially in the fields of European air quality, is described.

One finding of the recent report by Kraftfahrt-Bundesamt Deutschland (KBA) on the Volkswagen investigations is that the conventional testing methods used in the type-approval process are inadequate to ensure legally sound detection of illegal defeat devices. A case in point is the Volkswagen defeat device, which was not discovered during the type approval tests performed by the various type-approval authorities and technical services. Neither the tests for conformity nor the in-service tests of vehicles in operation are designed to and therefore currently able to identify the discrepancies between laboratory and real-world driving conditions. The EC introduced RDE regulations and the WLTP which ensure consideration of these discrepancies and state that the measurement conditions on the test benches in the laboratories are fundamentally different from “normal” operating conditions.[7]

Future RDE legislation will help to close the gap between vehicle emissions under test conditions and real driving situations and make it more difficult to use illegal defeat devices. However, the main goal of a revised type-approval process should be to ensure that the future vehicle fleet meets EU air quality provisions established to protect human health. Chapter 7 summarises the weaknesses of the existing type-approval process and includes recommendations for improvement. A revision of vehicle testing in its present form is urgently needed, especially in view of the fact that existing vehicle testing schemes were established in the 1960s and 1970s and that 10 years were needed to develop the WLTP.

---

[5] Proposal for a Regulation of the European Parliament and of the Council on the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles; COM(2016) 31 final (of 27.1.2016)

[6] See EC - DG Growth (2016)

[7] See KBA (2016), p.8; p.123 ff.

1. LEGAL FRAMEWORK FOR EC TYPE APPROVAL AND VEHICLE EXHAUST EMISSION MEASUREMENTS

KEY FINDINGS

Overall, the legal framework consists of a host of individual regulatory acts linked by a vast number of cross-references and is highly complex in its structure.

In many cases the legal requirements and formulations are imprecise and lack clarity, leaving room for MSs, type-approval authorities, OEMs and technical services to put forward their own interpretations.

Given this complex structure and interpretive value, only experts, mainly from OEMs and technical services, are able to cover the full scope and content of the legal framework and the practical implementation of type approval requirements.

The most important legal instruments for this study are:

- **Directive 2007/46/EC**

  of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles ("Framework Directive"; repealing Council Directive 70/156/EEC of 6 February 1970 on the approximation of the laws of the Member States relating to the type approval of motor vehicles and their trailers)

- **Regulation (EC) No 715/2007**

  of the European Parliament and the Council of 20 June 2007 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 and maintenance information (repealing Council Directive 70/220/EEC of 20 March 1970 on the approximation of the laws of the Member States relating to measures to be taken against air pollution by gases from positive-ignition engines of motor vehicles) ("the Regulation")

- **Regulation (EC) No 692/2008**

  of 18 July 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 and maintenance information ("the Implementing Regulation")

The harmonized technical requirements applicable to individual parts and characteristics of a vehicle are specified in separate EC Directives. There are over 50 separate EC Directives dealing with vehicles and their components (see Annex IV to the Framework Directive). However, their coverage is beyond the scope of the present analysis.

1.1. Directive 2007/46/EC (Framework Directive)

The EC type-approval process for most road vehicles is based on this Framework Directive. It has been applicable in EU Member States since 29 April 2009. The Framework Directive primarily covers the administrative procedures and some technical requirements relating to

the type approval of new vehicles. It applies to all 4-wheeled road vehicles (and to systems, components, separate technical units, parts and equipment intended for such vehicles). The focus of the present chapter is on the approval process for motor vehicles as a whole.

- **Relationship to the UNECE type-approval system**

In Europe, two type-approval systems exist side by side. This analysis focuses on the system based on the above referenced EU Directive and Regulations. The other system relies on United Nations Regulations discussed and adopted in the United Nations Economic Commission for Europe (UNECE). One major difference between the two systems is that EU type approval involves the approval of whole vehicles, vehicle systems and separate components whereas the UNECE system is only for the approval of vehicle systems and separate components. In both systems, approval testing is carried out by third parties such as the technical services.

UNECE Regulations to which the EU has acceded and which are listed in Part I of Annex IV and in Annex XI to the Framework Directive are part of the EC type-approval process in the same way as the separate directives or regulations (Art. 34 par. 1). Decision 97/836/EC governs the relationship between UNECE regulations and EU law in the context of type approval. Art 4 (4) of this Decision provides that when the Community votes in favour of a UNECE Regulation or an amendment to a UNECE Regulation, the decision is likewise required to state whether that Regulation is to become part of the EC whole vehicle type-approval system and replace existing law within the Community. Once the Community has decided to apply a UNECE Regulation on a compulsory basis, the annexes to the Framework Directive need to be amended as appropriate.

- **Type-approval procedure**

The Framework Directive describes several different type approval options, each entailing different requirements for OEMs that relate to the provision of information to type-approval authorities (see Art. 6). In the case of the EC whole vehicle type approval for passenger cars, the single-step type approval and the mixed type approval are the options most frequently chosen. In the single-step type approval, the complete vehicle is approved in a single process.[8] In a mixed type approval, the procedure consists of a step-by-step collection of the whole set of EC type-approval certificates for the systems, components and separate technical units of a given vehicle. This ultimately results in the approval of the vehicle as a whole.

"The advantage of these two approaches is that for some (mixed) - if not for all (single-step) - systems and technical units, testing in conformity with the regulations is performed without the obligation to apply for type approval as otherwise required under every single legal regulatory act. The collection of individual type approvals for each separate requirement is therefore not applicable." (Leif-Erik Schulte, TÜV NORD) *"Individual components are usually already type approved. For example, an existing approval for a headlamp (as an individual component) just has to be integrated into a system approval called 'Installation of lighting and light signalling devices'."* (Franz Wurst, BAV).

When a type of vehicle conforms with the type-approved vehicle, meets the technical type approval requirements confirmed by a technical service and complies with the conformity of production procedures, the type-approval authority can grant EC type approval. The characteristics of the type-approved vehicle are listed in detail by the OEM in the information folder or –package which is submitted to the type-approval authority by the time of application for type approval. Annex V determines the procedures to be followed.

[8] See Grote, K.-H./Feldhusen, J. (2014)

On request, the EC vehicle type-approval certificate must be presented to the type-approval authorities of the other MSs. The same is true for refusals or withdrawals of approvals (Art. 8 par 5 and par 6). The OEM becomes the holder of an EC type-approval certificate and issues a certificate of conformity (CoC) to accompany the respective vehicle (Art. 18). The CoC is a prerequisite for a vehicle's registration, sale and entry into service in the MS (Art. 26).

- **Technical services**

Technical services carry out the tests required for EC type approval on vehicles (components, separate technical units) that are (generally) representative of the types to be approved. technical services are organisations or bodies designated by the type-approval authority of a MS (which has the right to serve in this capacity as well, see Art. 41 par. 5) as a testing laboratory to carry out tests, or, in its capacity as a conformity assessment body, to carry out the initial assessment and other tests or inspections on behalf of the type-approval authority (Art. 3 par 31). Technical services are therefore a cornerstone of the current type-approval system. Their designation is based on Art. 41 which requires technical services to *"demonstrate appropriate skills, specific technical knowledge and proven experience"* in the areas covered by the Framework Directive. The referenced skills need to be demonstrated in an assessment report drawn up by a competent authority (i.e. the type-approval authority) (Art. 42). This report needs to be reviewed at least once every three years. With regard to technical service designation, reference is made to Euro Norm(EN) standards or standards issued by the International Organization for Standardization (ISO/IEC) to which technical services must adhere.

Technical services can be divided into the following categories on the basis of the testing activities they carry out for type approval:

- technical services that carry out or witness the respective tests (category A);
- technical services that only witness the respective tests performed at the OEM's facilities or at third-party facilities (category B);

"In the first case (technical service of category A), the technical service has its own laboratories for carrying out the tests, but is also allowed to conduct the testing at the OEM's facilities or at the facilities of a third party, where the tests are supervised." (Leif-Erik Schulte, TÜV NORD)

For the performance of CoP activities, there are also category C technical services that assess and monitor the OEM's procedures for the verification of conformity of production on a regular basis and category D technical services that supervise or perform tests or inspections as part of CoP surveillance. It is important to note that an OEM or a subcontracting party acting on the OEM's behalf can be designated a category A technical service.

- **Conformity of production (CoP)**

In a CoP certificate, the OEM states that each vehicle rolling off the assembly line has been built in conformity with the approved type. The MS granting type approval is required to ensure that the production of vehicles (systems, components, etc.) conforms with the approved type. In this context, cooperation between the MSs for the purpose of monitoring conformity is an option that has been provided for (e.g. if production is outside the MS granting type approval), but not mandatory. Only the MS that grants type approval must ensure that the CoP procedure is followed correctly by threatening with the sanction of type approval withdrawal for instance.

- **Access-to-information provisions**

Access-to-information provisions relate to information that is intended for users (this information needs to correspond to the particulars approved by the type-approval authority)

as well as to the information on components or separate technical units intended for the OEM required for type approval of these components or systems (Arts. 37 and 38).

- **Safeguard clauses**

The Framework Directive includes safeguard clauses for various non-compliance scenarios or situations where road safety or public health are at risk, for example.

When new vehicles jeopardise road safety, the environment or human health, MSs may refuse to register such vehicles or permit the sale or entry into service on their territory for a maximum period of 6 months. The OEMs, the other MSs and the EC must be notified and specifically advised on whether the decision was taken as a result of shortcomings in the regulatory acts or incorrect application of the relevant requirements. In the event of regulatory shortcomings, the EC is required to respond by amending the relevant legislative acts or by proposing appropriate amendments to the UNECE Regulations concerned. Whenever incorrect application of relevant requirements leads to a refusal, the EC is expected to take the appropriate measures to ensure compliance. The EC, once it has received the relevant notification, consults the parties concerned, in particular the type-approval authority that granted type approval for the vehicle in question, in order to prepare the decision (Art. 29 par. 2).

Whenever a new vehicle for which a CoC has been issued fails to conform to the approved type, the MS that granted type approval must take appropriate measures. This means that production must be brought into conformity with the approved type and the other MSs must be informed of the measures taken (Art. 30 par. 1). Type approval withdrawal is one of the options available.

Whenever a MS demonstrates that type-approved new vehicles carrying a CoC fail to conform with the approved type, this MS may ask the MS that granted type approval to verify that vehicles in production continue to conform with the approved type. The MS that granted type approval must take appropriate action within a period of no more than 6 months (Art. 30 par. 3). Other type-approval authorities in the EU must be notified of any type approval withdrawal within a period of 20 working days and advised on the reasons for withdrawal (Art. 30 par. 4). The MS that granted type approval may dispute the failure to conform. In this case, the EC acts as a mediator with a view to reaching a settlement (Art. 30 par. 5).

OEMs are obliged to recall any vehicles – once these have been type-approved and sold or entered into service - that present a serious risk to road safety, public health or environmental protection. In such cases, the OEM is obliged to:

- inform the authority that granted type approval;
- propose a set of measures to neutralize the risk;

The type-approval authority, for its part, must inform the authorities of the respective other MSs, which then ensure that the proposed measures are effectively implemented in their territories (Art. 32 par 2). If the measures are deemed insufficient or are not implemented quickly enough, the authority concerned must inform the type-approval authority that had granted the original type approval. This type-approval authority is then obliged to inform the OEM and can take all the appropriate measures, including type approval withdrawal.

1.2. Regulation (EC) 715/2007

“The Regulation” establishes common emission-related technical requirements for the type approval of motor vehicles (and replacement parts). It sets emission limits for atmospheric pollutants such as particulates and NO_x produced by EURO 5 and EURO 6 vehicles that are sold in the EU market with a view to improving air quality by reducing pollutants emitted in the road transport sector. EURO 5 is mandatory for passenger cars and light duty vehicles

registered since 1 January 2011 whereas EURO 6 applies to new vehicle registrations since 1 September 2015. The EURO 6 standard, in particular, aims to reduce NO_x emissions by introducing stricter emission limit values.

The Regulation includes a definition of so-called defeat devices: "*any element of design which senses temperature, vehicle speed, engine speed (RPM), transmission gear, manifold vacuum or any other parameter for the purpose of activating, modulating, delaying or deactivating the operation of any part of the emission control system, that reduces the effectiveness of the emission control system under conditions which may reasonably be expected to be encountered in normal vehicle operation and use*".

The use of defeat devices is explicitly prohibited unless their use is justified for reasons of engine protection or vehicle safety, they do not function longer than required to start the engine or the conditions are included in the test procedures for emission verification.[9]

When a vehicle complies with the Regulation (in particular with the EURO 5 and EURO 6 emission values) and its implementing measures, national MS authorities have no right to refuse to grant type approval or national type approval (or prohibit the registration, sale or entry into service of a new vehicle) on grounds relating to emissions or fuel consumption. In contrast, national MS authorities shall refuse to grant EC type approval or national type approval to new vehicle types that fail to comply with the Regulation and its implementing measures.

The Regulation further regulates the durability of pollution control devices. It states that durability testing of pollution control devices undertaken in the scope of type approval must cover a distance of 160 000 kilometres (km) and the OEM should have the possibility of resorting to test bench ageing[10] (Art. 4.2).

Furthermore, OEMs are obliged to provide access to vehicle repair and maintenance information[11]. The necessary information must be provided to independent operators (repair shops other than authorised dealers and repairers) through websites using a standardised format[12]. OEMs are entitled to charge "reasonable and proportionate fees" for this service. When applying for type approval, OEMs must prove to the type-approval authority that these provisions have been complied with (see Art. 6).

1.3. Regulation (EC) 692/2008

"The Implementing Regulation" sets out the detailed technical requirements necessary for the type approval of EURO 5 and EURO 6 specification vehicles. It lays down specific measures for the implementation of the provisions contained in Regulation (EC) 715/2007 relating to general OEM obligations, the provisions relating to tests (such as the prohibition of the use of defeat devices) as well as the provisions that ensure access to vehicle repair and maintenance information. Furthermore, it includes provisions on type approval

---

[9] The specific procedures and requirements are set forth in the Implementing Regulation (EC) No 692/2008, which lays down measures for the implementation of Articles 4, 5 and 8 of the Regulation.

[10] To ensure low emission levels throughout the useful life of vehicles, durability requirements are included in the current European vehicle emission legislation. For the durability demonstration the correct functioning of exhaust gas after-treatment systems should be ideally verified by several running standard test bench cycles to simulate accelerated ageing under the test conditions, especially thermal ageing. Alternatively to the ageing test on the test bench it is allowed to make usage of assigned deterioration factors.

[11] The Regulation defines this as "all information required for diagnosis, servicing, inspection, periodic monitoring, repair, re-programming or re-initialising of the vehicle and which the manufacturers provide for their authorised dealers and repairers, including all subsequent amendments and supplements to such information. This information includes all information required for fitting parts or equipment on vehicles".

[12] "OASIS Format" refers mainly to the technical specifications of OASIS Document SC2-D5, Format of Automotive Repair Information, version 1.0, 28 May 2003, available at https://www.oasis-open.org/committees/download.php/2412/Draft%20Committee%20Specification.pdf.

requirements, CoP and ISC as well as the access to information, on-board diagnostic (OBD) systems and pollution control devices.

OEMs must demonstrate that vehicles comply with the test procedures specified in a series of Annexes to the Implementing Regulation (Art. 3.4). These procedures serve a number of purposes, including the verification of average exhaust emissions as well as crankcase gas emissions and the determination of CO_2 emissions and fuel consumption. Furthermore, vehicles are subject to the tests specified in a table contained in Annex I listing the different types of tests applicable for the different vehicle types (vehicles with positive ignition engines or with compression ignition engines; mono-, bi- or flex-fuel vehicles) for which OEMs are obliged to provide the responsible technical service with a vehicle that is representative of the type submitted for approval (Art. 5 par. 8).

In a first step, the OEM must submit an application for type approval of a vehicle to the type-approval authority (with regard to emissions and access to vehicle repair and maintenance information). If all the relevant requirements are met, the type-approval authority grants type approval and issues a type-approval number. The type-approval authority also issues a type-approval certificate.

The specific CoP provisions require verification of the vehicle's production conformity for a type 1 test (verification of average exhaust emissions in ambient conditions). The type-approval authority randomly selects three vehicles from the series and tests them in accordance with the general and the technical requirements (which pertain to reference fuels or types of pollutants, for example) set forth by Annex III.[13] The tests must be carried out on vehicles straight off the production line. Once a "pass decision" has been reached for a specific pollutant, this decision is not changed on account of any additional tests carried out to reach a decision for other pollutants. However, if a "no pass decision" is reached for all the pollutants and a "no fail decision" is reached for one pollutant, another vehicle needs to be tested.

ISC measures must be appropriate to confirm functionality of the pollution control devices during a vehicle's useful life under normal conditions of use and are checked by the type-approval authority for a period of up to 5 years or until 100 000 km have been travelled, whichever occurs first.

The type-approval authority must carry out an ISC audit on the basis of information provided by the OEM. For ISC tests the OEM may group the vehicles to "in-service families" if they share specific parameters (such as combustion process, number of cylinders, type of cooling system, etc.). The OEM is obliged to ensure that the information provided to the type-approval authority is sufficiently comprehensive to ensure that ISC can be assessed, i.e. by selecting representative vehicle samples (the type-approval authority in cooperation with the OEM). Based on the information provided, the type-approval authority can decide, on the basis of the audit procedure, that the ISC is satisfactory, that further information is needed from the OEM or that ISC is unsatisfactory. In the latter case, the vehicle must be type-tested to verify proper selection of vehicles for testing and proper implementation of ISC control procedures.

In-service testing comprises emission tests (that verify the average exhaust emissions in ambient conditions) performed on pre-conditioned vehicles that have been selected in accordance with specified criteria (e.g. the vehicle must have been in service for at least 15 000 km or 6 months and must not exhibit any indications of abuse). Where more than one vehicle is found to be an outlying emitter, the type-approval authority must ask the OEM to submit a plan of measures to remedy non-compliance. The OEM has 60 days to submit the

[13] In terms of the technical specifications, reference is made to UNECE Regulation 83.

plan of remedial measures to the type-approval authority, which either approves or rejects it. The remedial measures are applicable to all vehicles that are likely to be affected by the same defect. The type-approval authority must assess whether there is any need to amend the type approval documents. The plan of remedial measures must include specific requirements such as a description of each vehicle type included in the plan or a description of the impact of the proposed remedial measures on the emissions, fuel consumption, driveability and safety of each vehicle type. Whenever the OEM proposes a change, repair or modification of components or vehicles, it may be required to carry out appropriate testing to demonstrate their effectiveness. The OEM must keep record of every vehicle recalled and repaired and of the workshops that perform the repairs. On request, the type-approval authority must be granted access to this information. While the OEM is expected to compile and provide all the relevant information, the type-approval authority is responsible for carrying out all procedures and tests that are necessary to ensure that ISC requirements are met.

Where the approval authority is not satisfied with the results of the tests (statistical procedure for ISC testing), the remedial measures (provisions on vehicles, systems components or separate technical units not in conformity with the approved type, see above) must be extended to vehicles in service belonging to the same vehicle type that are likely to be affected with the same defects (plan of remedial measures, see above). It is for the type-approval authority to approve the plan of remedial measures presented by the OEM whereas the OEM is responsible for the execution of the approved remedial plan. The type-approval authority has 30 days to inform the other MSs of its decision. These MSs can then demand that the same plan of remedial measures be applied in their territories.

2. STAKEHOLDER OBLIGATIONS REGARDING EMISSION MEASUREMENTS IN THE TYPE-APPROVAL PROCESS

The following tables list the legal obligations for each stakeholder regarding emission measurements in the course of and after the type-approval process. The stakeholders are:

- **European Commission;**
- **EU Member States;**
- **type approval authorities;**
- **technical services;**
- **OEMs;**

Every listed obligation includes the legal reference, an explanatory note and a link to the step of the type-approval process, which will be described in chapter 3.

2.1. Obligations of the Member States

Table 1: Obligations of the MSs according to the legislation

Category	Relevant provision	Obligation	Explanatory notes	Step
Conformity of production	2007/46/EC - Art. 13.3	To inform the OEM in case the type-approval authority finds fresh tests necessary.	If the MS finds that CoP arrangements are not being applied fresh inspections or fresh tests are necessary for purposes of making an amendment; the MS is then obliged to inform the manufacturer accordingly.	Amendment to type approval
Appropriate test procedures	715/2007 - Art. 4.2	To allow test bench ageing for OEM.	To comply with the durability test, the manufacturer should have the possibility to make use of test bench ageing subject to the implementing measures.	Type approval
Appropriate test procedures Emissions limits	715/2007 - Art. 10.1	To grant type approval when compliance is achieved.	Obligation to grant type approval, registration, etc. if compliance with emission (EURO 5 & 6 limit values) or fuel consumption regulations has been demonstrated.	Type approval
Appropriate test procedures Emissions limits	715/2007 - Art. 10.2	To refuse type approval if vehicles do not comply (with EURO 5 standard).	Obligation to refuse type approval, registration, etc., if compliance with emission (EURO 5 limit values) or fuel consumption regulations cannot be demonstrated.	Type approval

Appropriate test procedures Emissions limits	715/2007 - Art. 10.4	To refuse type approval if vehicles do not comply (with EURO 6 standard).	Obligation to refuse type approval, registration, etc., if compliance with emission (EURO 6 limit values) or fuel consumption regulations cannot be demonstrated.	Type approval
Appropriate test procedures Emissions limits	715/2007 - Art. 10.5	To withdraw type approval if NEW vehicles do not comply (with EURO 6 standard).	With new vehicles that are not in compliance with the Regulation and in particular with the Euro 6 limit values, the CoC loses validity; as a result, the MS must prohibit registration, sale or entry into service of such vehicles.	Post type approval

2.2. Obligations of the type-approval authorities

Table 2: Obligations of the type-approval authorities according to the legislation

Category	Relevant provision	Obligation	Explanatory notes	Step
Access to information	2007/46/EC - Art. 9.3	To complete the test result sheet.	The type-approval authority must: (a) complete all the relevant sections of the EC type-approval certificate, including the test results sheet appended thereto; (b) compile or verify the index to the information package; (c) issue the completed certificate.	Type approval
Conformity of production	2007/46/EC - Art. 12.2	To verify conformity of production.	The type-approval authority of the MS which has granted the EC type approval *may* carry out any of the checks or tests prescribed in any of the regulatory acts on samples taken on the manufacturer's premises, including production facilities.	Conformity of production
Appropriate test procedures	2007/46/EC - Annex V.3.a and b	To take action where no approval certificates for any of the relevant regulatory acts are available.	If no approval certificates are available, the EC type-approval authority must: (a) arrange for the necessary tests and checks as required by each of the relevant regulatory acts; (b) verify that the vehicle conforms to the particulars in the vehicle information folder and that it meets the technical requirements.	Type approval
Access to information	692/2008 - Art. 3.3	To inform the EC of the circumstances	This provision concerns EC type approvals and relates to emissions and vehicle repair	Post type approval

		of each type approval granted under this paragraph.	as well as maintenance information under the Implementing Regulation.	
Emission limits Pollutant control devices (durability)	692/2008 - Art. 3.9	To refuse approval if the information provided with regard to after-treatment devices is insufficient. To provide information on the performance of NO_X after-treatment devices and the EGR system.	This provision calls for the verification that the NO_X after-treatment device reaches a sufficiently high temperature for efficient operation within 400 seconds after a cold start at -7 °C.	Type approval
Access to information	692/2008 - Art. 6.2	To notify the decision to grant such type approval to all type-approval authorities in the other MS.	Notification of decision to issue type approval with regard to emissions and vehicle repair and maintenance information for a vehicle with an OBD system, even though the system contains one or more deficiencies.	Type approval
In-service conformity	692/2008 - Art. 9.6	To extend remedial measures to same-type vehicles in service when the procedure for ISC testing is not satisfactory.	Relates to type-approved vehicles: where the type-approval authority is not satisfied with the results of the tests, the remedial measures must be extended to vehicles in service belonging to the same vehicle type which are likely to be affected with the same defects.	In-service conformity
In-service conformity	692/2008 - Annex II Appendix 3	To request information from the technical service if discrepancies	The type-approval authority may also take into account information from surveillance programmes, conduct all the procedures and tests necessary to ensure that the requirements regarding in-service conformity are met, and, in the event of discrepancies or disagreements in the	In-service conformity

		within ISC are identified.	assessment of the information supplied, the type approval must request clarification from the technical service that conducted the type-approval test.	

2.3. Obligations of the technical services

Table 3: Obligations of the technical services according to the legislation

Category	Relevant provision	Obligation	Explanatory notes	Step
Emission limits Appropriate test procedures	2007/46/EC - Art. 41.2	To carry out or supervise tests.	To carry out or supervise the tests required for approval or the inspections specified, except where other procedures or specifications are permitted.	Type approval

2.4. Obligations of the European Commission

Table 4: Obligations of the EC according to the legislation

Category	Relevant provision	Obligation	Explanatory notes	Step
Emission limits In-service conformity	715/2007 - Art. 4.2	To review test procedures regarding tailpipe emissions as tested against emission limits.	In-service conformity must be checked, particularly for tailpipe emissions as tested against emission limits set out in Annex I. In order to improve control of evaporative emissions and low ambient temperature emissions, the test procedures must be reviewed by the EC.	In-service conformity
Appropriate test procedures	715/2007 - Art. 14.2	The EC must adopt specific provisions on the measurement and calculation of particulates by no later than on entry into force of Euro 6 (1. September 2014).	The EC is obliged to adopt the following measures without lowering the existing ambition level with regard to the environment: (a) amendment of this Regulation in accordance with the regulatory procedure for the purpose of recalibrating the particulate mass-based limit values and introducing particle number-based limit values so that these correlate broadly with the petrol and diesel mass limit values; (b) adoption of a revised measurement procedure for particulates and a particle number limit value.	General obligation

Appropriate test procedures	715/2007 - Art. 14.3	To adapt specific procedures, tests and requirements for type approval as well as the test cycles used to measure emissions in case these are no longer adequate or no longer reflect real-world emissions.	The EC must keep under review the procedures, tests and requirements referred to as well as the test cycles used to measure emissions. If a review finds that these are no longer adequate or no longer reflect real-world emissions, they must be adapted so as to adequately reflect the emissions generated by real driving on the road.	General obligation

2.5. Obligations of the original equipment manufacturers

Table 5: Obligations of OEMs according to the legislation

Category	Relevant provision	Obligation	Explanatory notes	Step
Appropriate test procedures	2007/46/EC - Art. 11.2	To select vehicles for the performance of tests.	The required tests must be performed on vehicles, components and separate technical units that are representative of the type to be approved. However, in agreement with the type-approval authority, the manufacturer may select a vehicle (a system, a component or a separate technical unit) which, while not representative of the type to be approved, combines a number of the most unfavourable features with regard to the required level of performance. Virtual testing methods may be used to aid decision-making during the selection process.	Type approval
Access to information	715/2007 - Art. 4.1	To demonstrate that vehicle sold, registered and entered into service are type-approved, incl.	Manufacturers must demonstrate that all new vehicles sold, registered or entered into service in the Community are type-approved in accordance with the Regulation and its implementing measures. These obligations include meeting the emission limits.	General obligation

		conformity with EURO 5 & 6 standards.		
Durability of pollution control devices In-service conformity	715/2007 - Art. 4.2	To ensure that type approval procedures for verifying durability of pollution control devices are followed.	Manufacturers must ensure that type approval procedures for verifying conformity of production, durability of pollution control devices and in-service conformity are met.	Type approval, conformity of production, in-service conformity
In-service conformity Emission limits	715/2007 - Art. 4.2	ISC checks must guarantee that tailpipe and evaporative emissions are effectively limited.	In addition, the technical measures taken by the manufacturer must be such as to ensure that the tailpipe and evaporative emissions are effectively limited throughout the normal life of the vehicles under normal conditions of use.	In-service conformity
Appropriate test procedures Emission limits	715/2007 - Art. 4.2	*It is unclear who is responsible for this obligation of checking tailpipe emissions against emission limits: the MS, the type-approval authority or the OEM.* Revision of test procedures by the EC.	In-service conformity must be checked, particularly for tailpipe emissions as tested against emission limits. In order to improve control of evaporative emissions and low ambient temperature emissions, the test procedures must be reviewed by the EC.	In-service conformity
Defeat device	715/2007 - Art. 5.2	To ensure that defeat devices do not reduce the effectiveness of emission	The use of defeat devices that reduce the effectiveness of emission control systems must be prohibited. Exceptions are related to engine and vehicle safety or when the effects of the device are taken into account in the test procedure.	Type approval

		control systems.		
Appropriate test procedures	692/2008 - Art. 3.1	Vehicles and reference fuel must comply with test procedure.	In order to receive an EC type approval with regard to emissions and vehicle repair and maintenance information, the OEM must demonstrate that the vehicles and reference fuels used comply with the test procedures specified.	Type approval
Emission limits	692/2008 - Art. 3.6	General obligations of the OEMs to ensure that the emissions test results comply with the applicable limit value.	The manufacturer must ensure that the emissions test results comply with the applicable limit value under the specified test conditions.	General obligation
Emission limits	692/2008 - Art. 3.8	Ensure that ventilation system does not permit the emission of any crankcase gases into the atmosphere.	For the Type 3 test set out in Annex V, the manufacturer must ensure that the engine's ventilation system does not permit the emission of any crankcase gases into the atmosphere.	Type approval
Appropriate test procedures Emission limits	692/2008 - Art. 3.9	Obligations regarding measuring emissions at low temperatures.	OEM must present to the type-approval authority information showing that the NO_X after-treatment device reaches a sufficiently high temperature for efficient operation within 400 seconds after a cold start at -7 °C as described. In addition, the manufacturer must provide the approval authority with information on the operating strategy of the exhaust gas recirculation system (EGR), including its functioning at low temperatures. This information must also include a description of any effects on emissions.	Type approval

3. OVERVIEW OF THE EU TYPE-APPROVAL PROCESS

KEY FINDINGS

The most commonly used type approvals are single-step and mixed type approvals. Their advantage is that individual type approvals need not be collected for every single technical unit, component or system regulated in the various separate legal acts.

Emission testing prior to type approval is performed on a representative vehicle chosen by the OEM.

CoP which starts with the initial assessment, must be maintained by the OEM after successful type approval. The type-approval authority conducts CoP audits at more or less regular intervals.

ISC testing includes emission testing on vehicles in operation as well as audits by the type-approval authority.

The type-approval process is a mechanism in which OEMs need to meet internationally agreed environmental, safety and security standards applicable in the production of new on- and off-road vehicles, vehicle systems and components. The standards are specified in the relevant legislation adopted by the EU and the UNECE. For OEMs that produce large numbers of vehicles for the European market the EC Whole Vehicle Type Approval (ECWVTA) is the most suitable option. The ECWVTA permits an OEM to sell, register and enter into service the approved vehicle model across all EU MSs without requiring further testing at country level.[14] This means that separate technical units, components, systems or whole vehicles approved by a type-approval authority in one MS must be acknowledged in all other MSs as well. This process guarantees that the sample vehicle of a new model with distinct specifications complies with the standards and that the serial production of this model does not deviate from the recorded and approved specifications.[15]

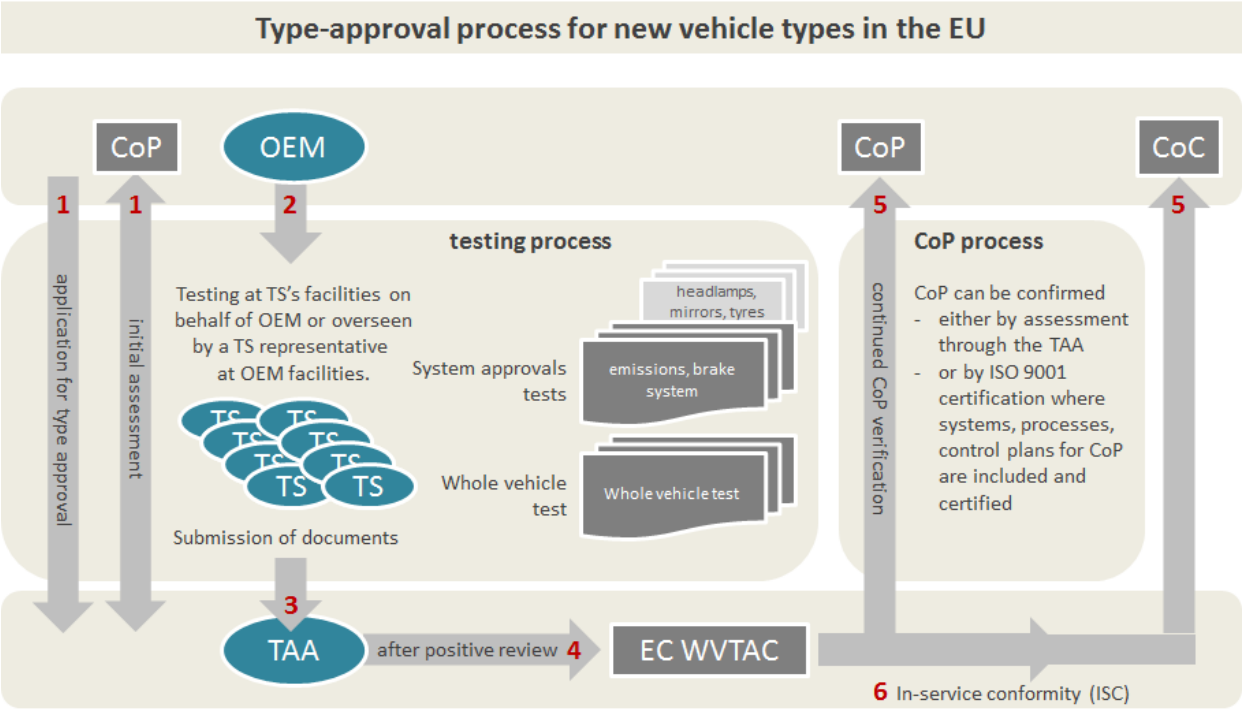
As mentioned in chapter 1, the OEM can choose from different type-approval process options (multi-stage, step-by-step, etc.). Irrespective of the type approval options, the type-approval process includes the steps shown in Figure 1 below:

- **Step 1: OEM's application for type approval & initial CoP assessment.**
- **Step 2: Testing process.**
- **Step 3: Submission of documents.**
- **Step 4: Granting of the ECWVTA & conclusion of CoP arrangements.**
- **Step 5: Vehicle registration & continued CoP verification.**
- **Step 6: In-service conformity (ISC).**

[14] There are also approval options for small national or EU series or for individual vehicles.

[15] See VCA (2016a)

Figure 1: EU type-approval process



abbreviations:

ECWVTAC...	*European Commission Whole Vehicle Type-Approval Certificate*
CoC...	*Certificate of Conformity*
CoP...	*Conformity of Production*
OEM...	*Original Equipment Manufacturer, here the car manufacturer*
TS...	*Technical Service*
TAA...	*Type-approval authority*

Source: Environment Agency Austria (2016)

3.1. Step 1: OEM's application for type approval & initial CoP assessment

The OEM's application for type approval must include the required information about the design and construction of the vehicle model (information package) for which approval is sought.

When the OEM applies for type approval, it asks a national type-approval authority for:

- **an initial assessment of the production processes on the basis of CoP standards;**
- **inspection of a pre-production vehicle model to guarantee that the car meets the required environmental, safety and security standards;**

All MSs must establish or appoint a national type-approval authority and notify this type-approval authority to the EC. For type approval purposes, the OEM is free to choose a type-approval authority in any of the EU's MSs.

Type approval may only be granted once the OEM has established conformity of production (CoP). The conformity of production procedure aims to ensure that the serial production of a vehicle type complies at all stages with exactly the same specifications as those approved for the relevant vehicle type. The MS granting type approval must ensure that this regulatory requirement is complied with. The CoP process is split into two parts:

- **CoP before type approval**
  (initial assessment plus product conformity arrangements).

- **CoP after type approval**
  (continued verification arrangements).[16]

The initial CoP assessment includes verification of the OEM's quality management system by the type-approval authority or a designated technical service on the type-approval authority's behalf. In the latter case, the technical service merely performs the examination while the type-approval authority continues to be responsible for the final assessment. The type-approval authority must check whether satisfactory arrangements and procedures for ensuring effective quality control are in place at the OEM's facilities so that components, systems, separate technical units or whole vehicles - while still in production - conform with the approved type. In performing the assessment, the type-approval authority can deem different quality management system standards such as EN ISO 9001:2015 as sufficient. It must be noted that, for now, the quality standards applied at OEMs and technical services may vary between the MSs.

For the purpose of the EC Whole Vehicle Type Approval, the initial assessment does not need to be repeated, but should be supplemented by an assessment covering all the production facilities and activities relating to the assembly of the whole vehicle and not covered by the former assessment. *"The initial assessment can be left out if the potential applicant for type approval has already been listed as a registered OEM at the type-approval authority at an earlier time. In this case an initial assessment has already been carried out and assessed positively by the type-approval authority."* (Leif-Erik Schulte, TÜV NORD)

3.2. Step 2: Testing process

The OEM must make sure that the technical service it intends to authorise to perform the actual test of the vehicle model has been designated in advance as a technical service in the MS where the chosen type-approval authority is based. In each of the MSs, the respective type-approval authority is responsible for the designation of technical services as test laboratories to carry out tests.[17]

With regard to exhaust emission testing prior to type approval, a test must be carried out on the vehicle described in the initial information package.[18] *"Usually, the OEM suggests a representative vehicle."* (Leif-Erik Schulte, TÜV NORD)

"[…] for exhaust pollutant emissions often only one vehicle of a type is tested — the one with the (expected) highest exhaust pollutant emissions, as the exhaust emission limits are simply pass or fail, and the OEM can be sure that all other vehicles of the same type will have lower exhaust pollutant emissions and would therefore also meet the limit."[19]

If the test statistics conform with the criteria that allow passing of the series for all the pollutants, the type-approval authority accepts the series. The technical service carries out or witnesses the practical test, undertakes the inspection for missing type approvals in accordance with all the individual technical legal regulations and draws up the necessary test reports and further documents.[20]

---

[16] See step 5 of the type-approval process.

[17] The type-approval authority of a MS could serve in this capacity as well (acc. to 2007/46/EC, Art. 41 par. 5), but no type-approval authority in the EU currently has its own testing laboratories.

[18] For technical testing details and the verification of exhaust emissions after a cold start (type 1 test in the NEDC on a test bench), Directive 2007/46/EC (Annex 4, Part II) refers to UNECE Regulation No. 83. EC Regulation No 692/2008 refers to the same UNECE Regulation (Annex III).

[19] ICCT (2015), p.10

[20] See KBA (2009)

3.3. Step 3: Submission of documents

The technical service submits the complete set of documents to the type-approval authority on behalf of the OEM, usually together with the OEM's application for type approval.

The type-approval authority reviews the submitted documents for completeness, correctness of the individual technical legal regulations applied, content and eligibility of the vehicle and its components.[21] *"The issue of the whole vehicle approval does not in itself involve testing, but a production sample of the complete vehicle is inspected to check that its specification matches the specifications contained in all the separate Directive approvals."*[22]

3.4. Step 4: Granting of the ECWVTA & concluding CoP arrangements

Once a review of the test reports, the OEM's documents and initial CoP assessment arrives at a positive outcome, the type-approval authority grants the ECWVTA, sends the type approval documents to the OEM and all the other EU MSs and assists the OEM in issuing the CoC.

3.5. Step 5: Vehicle registration & continued CoP verification

After type approval has been granted by the type-approval authority, the OEM is allowed to produce an indefinite number of the approved vehicle types. The OEM can register the approved vehicle model across Europe, without having to undertake further testing in other MSs, and issue a CoC for each vehicle that corresponds to the approved vehicle model. The CoC serves as the basis for vehicle registration in the MSs.

After successful type approval, the OEM is obliged to take the necessary measures to maintain the CoP (continued verification arrangements). Once an ECWTA has been granted, the type-approval authority must verify the existence of adequate arrangements and documented quality control plans at the OEM's facilities by performing a CoP audit and carry out tests or related checks, at specified intervals, as required to verify continued conformity with the approved type. The type-approval authority can perform surveillance activities to check these measures at any time.

The type 1 test must be carried out on a vehicle of the same specification as the one described in the type-approval certificate. Three vehicles from the series are randomly selected and tested. At the OEM's request, the tests may be carried out on vehicles with a maximum of 3 000 km or 5 000 km depending on the ignition system. After selection by the type-approval authority, the OEM must not make any adjustments to the vehicles.

3.6. Step 6: In-service conformity (ISC)

"CoP and ISC are two different processes. The ISC can be interpreted as a form of market surveillance in order to monitor vehicles which are in operation." (Volker Noeske, Deutscher Kraftfahrzeug-Überwachungs-Verein (DEKRA)) The OEM is obliged to verify conformity of in-service vehicles,[23] a process which is then audited by the responsible type-approval authority. Therefore, the ISC measures must be appropriate for confirming the functionality of the pollution control devices during the normal life of the vehicles under normal conditions of use. The OEM is obliged to select in-service vehicles from two representative MSs (e.g. with the largest annual sales), but with substantially different vehicle operating conditions (hot climate versus cold climate or mountainous topography versus lowlands). Other criteria are that the vehicles must not be older than 5 years or show a mileage below 100 000 km.

---

[21] See KBA (2009)

[22] See VCA (2016b), p.2

[23] Except for OEMs of small-scale serial production (annual sales of up to 5 000 across the EU).

"At the moment, this form of ISC is only for exhaust emissions properly anchored in the context of type approval." (Volker Noeske, DEKRA)[24]

[24] It should be noted that this is not the case for the ISC of noise emissions which is called in-use-compliance. Noise emissions of vehicles have to be in conformity with production, but the in-use-compliance – if executed at all – only results in a national standard noise measurement that is only applied for the most striking vehicles.

4. INSIGHTS INTO THE PRACTICAL IMPLEMENTATION OF THE EU TYPE-APPROVAL PROCESS AT COUNTRY LEVEL

KEY FINDINGS

OEMs get to choose from 28 different type-approval authorities and more than 300 technical services. Commercial relationships may give rise to conflicts of interest.

Expertise and financial resources vary greatly between the type-approval authorities in the EU. Moreover, interaction between type-approval authorities and technical services is hampered by a lack of harmonisation and specification. As a consequence, type-approval process quality standards vary throughout the EU.

In some cases, the technical services are partly owned by the OEMs and integrated into a national type-approval authority. Moreover, technical services frequently offer research and development services. There is an obvious lack of separation of powers.

ISC verification for passenger cars is based on laboratory tests in the NEDC at the OEM's test facilities.

There is no testing of passenger car emissions under real-world driving conditions by an independent third party.

In the event of non-conformity, MSs that did not issue the underlying type approval are unable to take proper action in the current legal framework, which also represents an impediment to market surveillance programmes as these are usually financed by the MSs.

Each EU MS is obliged to establish a type-approval authority. Hence, the OEM is able to choose from 28 different type-approval authorities and from a specific number of technical services designated in the MS of the selected type-approval authority. As a result, networks of cooperation have emerged over time. Due to a lack of public data, it is all but impossible to itemise these networks of cooperation and their background. For this reason, a questionnaire (see annex) was developed and several stakeholders in different fields of activity were consulted in order to gain insight into the system. The consulted stakeholders are listed in the table below.

Table 6: Consulted stakeholders

organisation	type	consultation
EC – Directorate-General (DG) Growth	*legislation*	no feedback
EC - Directorate-General (DG) Environment	*legislation*	no feedback
European Environment Agency (EEA)	*legislation*	no feedback

Bundesministerium für Verkehr, Technologie und Innovation (BMVIT)	*legislation (AT)*	interview
Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft (BMLFUW)	*legislation (AT)*	written documents
Joint Research Centre (JRC) - Institute for Energy and Transport (IET)	*research*	no feedback
Joint Research Centre (JRC) - Institute for Environment and Sustainability (IES)	*research*	no feedback
Handbook Emission Factors for Road Transport (HBEFA) Group	*research*	written comments
Bundesanstalt für Verkehr (BAV) - Division Type Approval	type-approval authority (AT)	interview
Kraftfahrt-Bundesamt Deutschland (KBA)	type-approval authority (DE)	no resources at time of request
Centre National de Réception des Véhicules (CNRV)	type-approval authority (FR)	no feedback
Rijksdienst voor het Wegverkeer (RDW)	type-approval authority / technical service (NL)	no feedback
Vehicle Certification Agency (VCA)	type-approval authority / technical service (GB)	no feedback
Graz University of Technology (TUG) – Institute of Internal Combustion Engines and Thermodynamics	technical service / *research (AT)*	interview

Technischer Überwachungsverein (TÜV) NORD Service GmbH & Co. KG	technical service (DE)	interview
DEKRA e.V.	technical service (DE)	interview
Centre d'Essais et de Recherche Appliqué à la Mobilité (UTAC) - Centre d'Essais et de Recherche Appliqué á la Mobilité (CERAM)	technical service (FR)	no feedback
European Automobile Manufacturers Association (ACEA)	*Representing OEMs*	no feedback
Association for Emissions Control by Catalyst (AECC)	*supply industry*	interview
Allgemeiner Deutscher Automobil-Club (ADAC)	*automobile club (DE)*	written comments
International Council on Clean Transportation (ICCT)	NGO	interview
European Federation for Transport and Environment (T&E)	NGO	interview

This chapter provides an overview of the stakeholder consultation outcome, differentiated by the main sub-processes within the overall European type-approval process. The information collected has been validated, harmonised and compared with an analysis of the European Environment Agency (EEA) database on the monitoring of CO_2 emissions from passenger cars in 2014[25] and of the lists of the type-approval authorities in the EU[26] and the technical services in each EU MS[27]. It must be noted that the information given in the following chapters does not necessarily reflect the views of each of the consulted stakeholders.

4.1. The OEM selecting the type-approval authority

The first step in starting a type-approval process is to apply for type approval with a national type-approval authority selected by the OEM and to simultaneously undertake an initial CoP assessment. The initial CoP assessment can be implemented by way of an audit at the OEM's facilities, optionally supported by a certification process in accordance with quality management standards such as EN ISO 9001:2015. These provisions document a process that is performed at the OEM's manufacturing plant, but do not provide any verification of the technical processes. *"In practice some type-approval authorities accept ISO standards only, but not all."* (Volker Noeske, DEKRA*) "The type-approval authority is free to demand, in addition, further appropriate records that the OEM needs to provide to pass the initial assessment."* (Leif-Erik Schulte, TÜV NORD) *"ISO standards only help with the initial CoP assessment."* (Volker Noeske, DEKRA).

[25] See EEA (2016)
[26] See EC (2016a)
[27] See EC (2016b)

One of the responsibilities of a type-approval authority is to interpret the EC's type approval legislation, as the provisions included therein do not fully define the procedures in the testing scheme. Moreover, the personnel and financial resources available to the type-approval authorities vary. As a result, the numbers and technical abilities of the type-approval authority's staff vary in the different MSs as do the costs that are charged for type approvals. However, the costs seem to be of less importance for an OEM when it comes to selecting a specific type-approval authority. It can be concluded though that type-approval authorities provide different quality standards in the EC type-approval process.

The OEM's decision in selecting a type-approval authority is based on the following characteristics:

- **short processing period (preferably only a few days);**
- **low frequency and intensity of post-CoP audits;**
- **low rate of reviews of the test results processed by the technical service;**
- **low type-approval costs for the OEM;**

Given these characteristics and a lack of consistent quality control by the EC, a certain degree of competition has developed between the type-approval authorities. *"Some* type-approval authorities *are funded by processing type approvals to a high extent – 70% of the entire budget in the case of VCA in the United Kingdom; the Vehicle Technology and Information Centre - RDW - in the Netherlands almost entirely."* (Julia Poliscanova, T&E) The type-approval authority and the OEM enter into a commercial relationship, which may give rise to a conflict of interest.

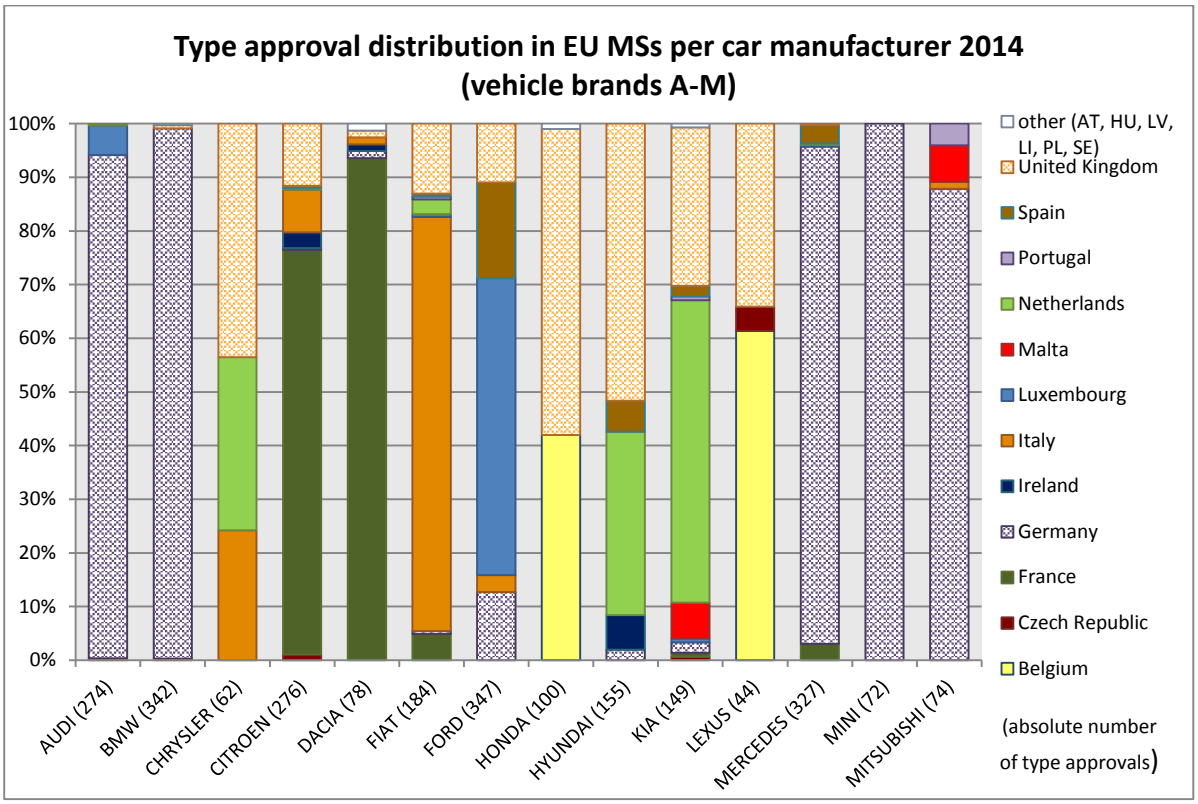
Figure 2 and Figure 4 show the distribution of type approvals in the EU MSs per OEM based on the European Environment Agency (EEA) database on the monitoring of CO_2 emissions from passenger cars in 2014. German OEMs (Audi, BMW, Mercedes or Volkswagen) mostly decided to cooperate with the German Federal Motor Transport Authority – KBA whereas the French OEMs (Citroen, Peugeot, Renault) and Dacia mainly applied for type approvals at the Centre National de Réception des Véhicules (CNRV) in France. Opel operates manufacturing plants in Austria, Germany, Hungary, Poland, Portugal, Spain and the United Kingdom.[28] However, more than 40% of the type approvals were granted in the Netherlands by the Vehicle Technology and Information Centre (RDW).

Some non-European OEMs (including Chrysler, Hyundai or Kia) tend to cooperate with the type-approval authorities in the Netherlands and Luxembourg. 97 % of all type approvals for Porsche passenger cars have likewise been granted in Luxembourg. *"The Luxembourg type-approval authority, for example, shows a very high number of type approvals issued despite not having any car manufacturing industry."* (Julia Poliscanova, T&E)

It must be noted that this data provides figures for the ECWVTA only, but fails to provide any information on the number of system approvals.

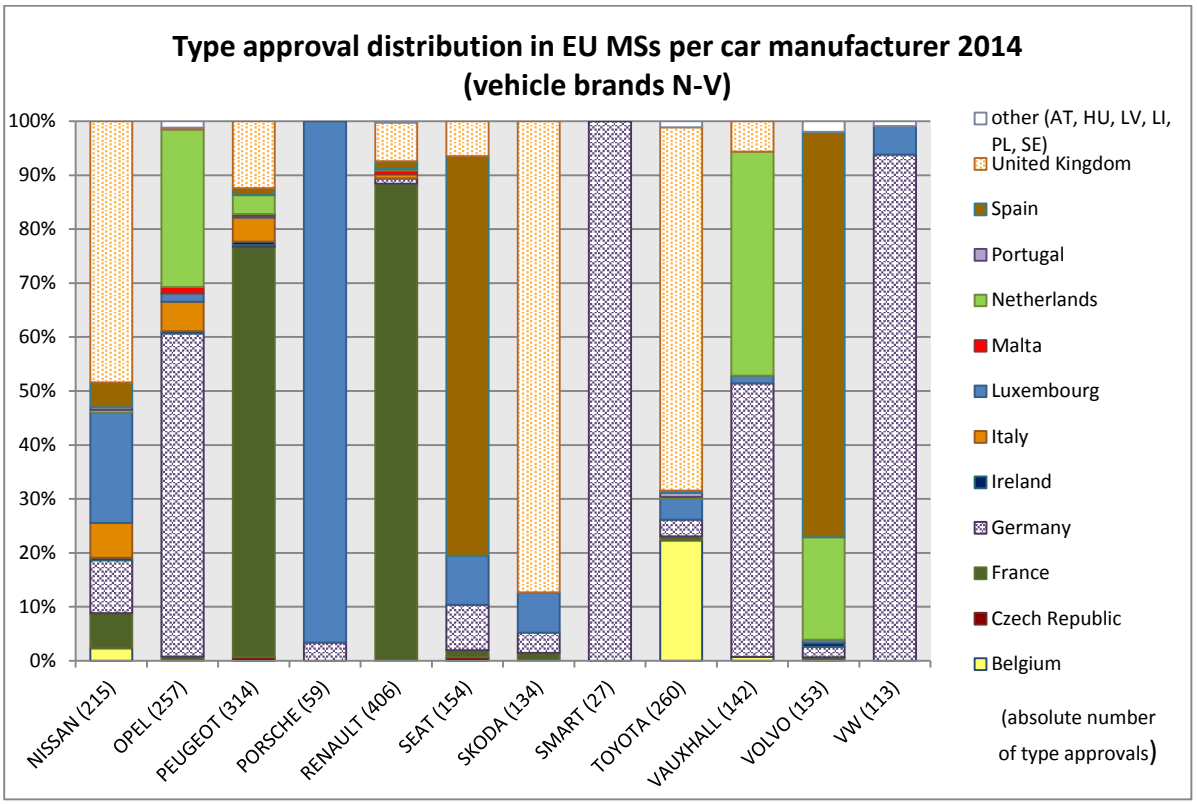
[28] See Opel (2016)

Figure 2: Type approval distribution by OEM in 2014 (1)



Source: Own illustration based on EEA (2016)

Figure 3: Type approval distribution by OEM in 2014 (2)



Source: Own illustration based on EEA (2016)

4.2. The OEM selecting the technical service

As previously mentioned, category B technical services are only permitted to witness the respective tests at the OEM's facilities or in the facilities of a third party. Thus, category B technical services do not need to provide, operate or fund testing facilities. They can charge substantially lower fees by merely witnessing the tests. Apart from the financial advantage, the OEM gets to keep control of the testing process on its own premises. *"Theoretically all testing can be done and increasingly is done by witnessing the tests at the OEM's facilities, roughly estimated more than 75%."* (Volker Noeske, DEKRA)[29] *"As the OEMs have own testing facilities available, CO_2-emission testing is mainly supervised by technical services at the facilities of the OEM."* (Leif-Erik Schulte, TÜV NORD).

In selecting a specific technical service, the OEM relies on the following criteria:

- **designation by the selected type-approval authority;**
- **vicinity of the technical service's testing facilities (in case of a category A technical service);**
- **flexibility of the technical service's staff (in case of a category B technical service);**
- **technical expertise;**
- **experience of the technical service's staff;**
- **technical capacity of the technical service (when the OEM has no testing facilities or in order to absorb testing peaks);**
- **low costs for the OEM;**
- **trustworthy and longstanding relationship between OEMs and technical services;**
- **conflict-free cooperation with OEMs;**

The technical service and the OEM enter into a commercial relationship, which may give rise to a conflict of interest as technical services are subject to competition. They are expected to act as an independent inspection body. Bosch Engineering GmbH, for example, is a technical service[30] designated by the German type-approval authority[31] that uses the opportunity of supporting the OEM in its effort to develop parts and systems which might also be tested by the Bosch Engineering GmbH in the framework of the type-approval process later on.[32] The ownership structure may exacerbate this conflict of interest further. The German technical service MBTech EMC GmbH is part of the MBTech Group, for example, of which Daimler holds a 35 % stake.[33] In the context of this analysis, it must be noted that MBTech EMC GmbH does not perform emission tests. Apart from this, the commercial competition between the technical services and the partially vague provisions offering room for interpretation hamper any effort to ensure high-quality testing. There is no transparency in pricing, for instance, or with respect to the intensity and quality of testing.

The number of technical services designated by a type-approval authority varies in the different MSs. The type-approval authorities in Germany (81), the Netherlands (40) or the United Kingdom (26), for example, have designated a high number of technical services,

---

[29] See also ICCT (2015)

[30] Bosch Engineering GmbH was designated by the KBA on 29 October 2015. Hence it is not yet listed on the EC webpages, which date from 10 April 2015; KBA registration number: KBA-P 00074-15.

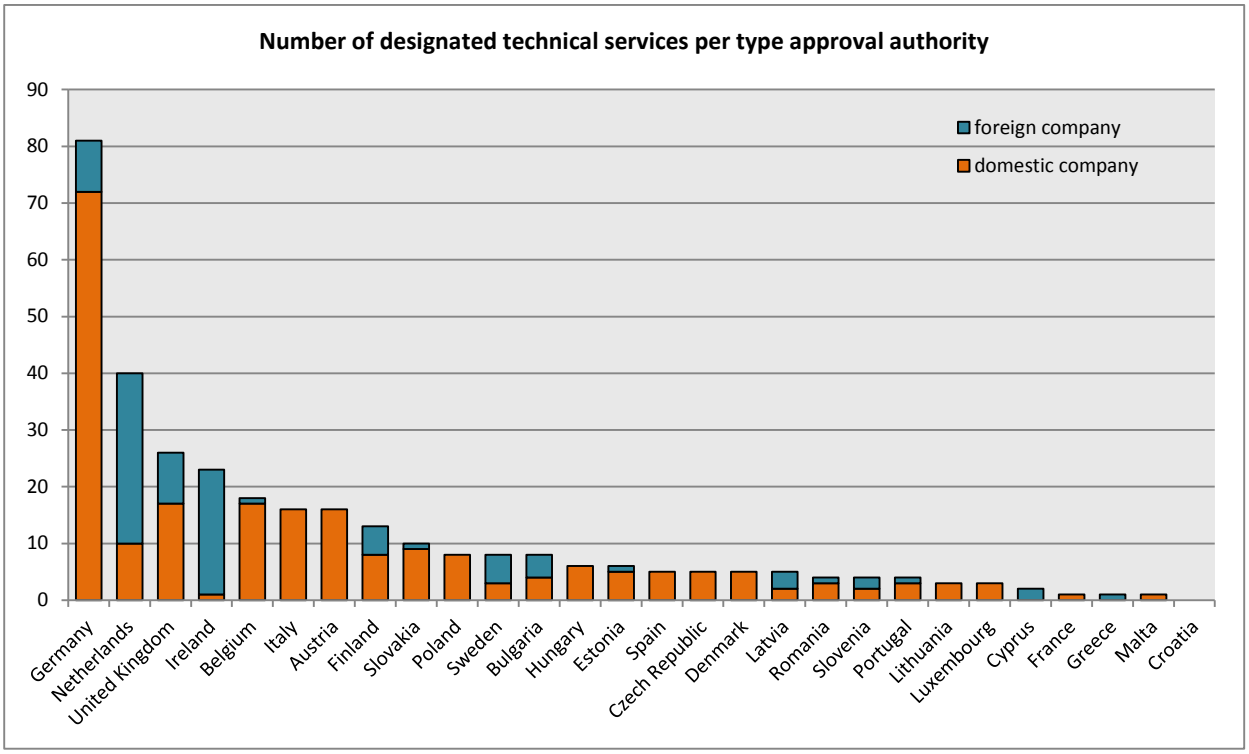
[31] In accordance with EC 715/2007 (UNECE Regulations 24, 83, 85 and 101).

[32] See Bosch (2016)

[33] See also ICCT (2015), p.9

whereas the type-approval authorities in Malta, Greece or France only cooperate with one technical service each. Figure 4 shows the number of technical services designated by each type-approval authority and the distribution of technical services registered in the MS of the type-approval authority and those registered in foreign countries. However, TÜV Rhineland has been designated by 7 type-approval authorities, for example, and has established national departments in each of the MSs where these 7 type-approval authorities are located. As a result, it is listed as a domestic company. Designating only one technical service helps to prevent commercial competition (as mentioned above) and may lead to higher quality testing, provided that the technical service is fully independent of the type-approval authority.

Figure 4: Number of technical services per type-approval authority



Source: Own illustration based on EC (2016)

4.3. Interaction between technical service and type-approval authority

A technical service can be listed in one or several MSs of the European Union. If a technical service wishes to operate in a specific MS (which does not necessarily have to be the MS the technical service is registered in), it needs to be designated by the type-approval authority in this specific MS. If the technical service is already certified in accordance with DIN (Deutsches Institut für Normung) EN (European Norm) ISO/IEC 17025:2005 and DIN EN ISO/IEC 17020:2012, it can be designated without further action. If the technical service has yet to be certified, the type-approval authority must conduct an audit based on these provisions. In practice, the requirements for a technical service that is to be designated by a specific type-approval authority, e.g. the necessary qualifications of the staff of the technical service, vary widely.

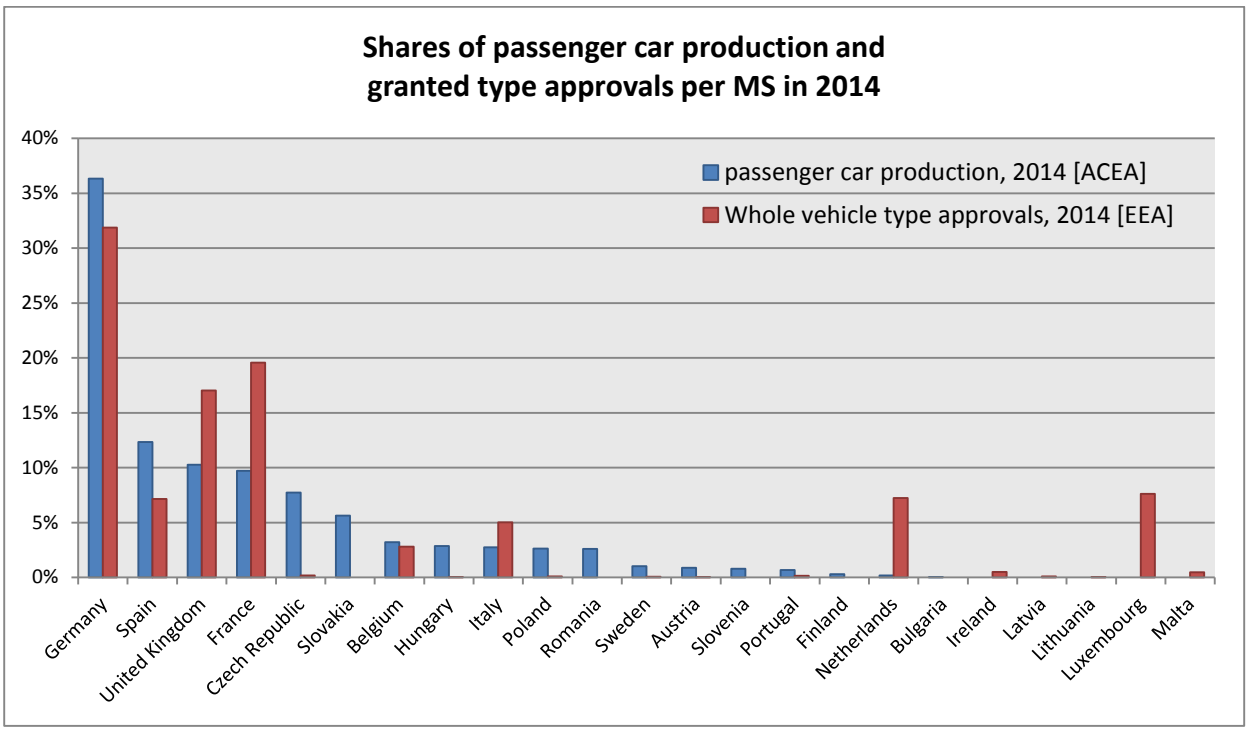
Cooperation and interaction between the 28 type-approval authorities and the more than 300 technical services in the EU is hampered by a lack of harmonisation and specification. Although the 28 type-approval authorities are coordinated within a type-approval authority expert group at European level, the national frameworks for the activities of the technical services vary for a number of reasons, including differences in the interpretation of the European provisions. The technical services themselves may interpret the given framework

differently, too, depending on the framework's level of detail. This may result in major disparities in the design and quality of testing within the same European type-approval process, which are also driven by the economic interests of both the type-approval authorities and the technical services. Moreover, there is no standard for the number of employees as well as the technical qualifications of the type-approval authority's staff. As a consequence, technical services may adapt their type-approval processes according to the different interpretations of the same law offered by the type-approval authorities in the different countries. The type-approval authority's willingness and expertise to adequately scrutinise tests conducted by the technical service may be called into question under these circumstances. *"The first point of contact for a car manufacturer is very often the technical service which can also offer consulting services to guide the car manufacturer through the type-approval process."* (Julia Poliscanova, T&E)

As shown in Figure 5 below, the United Kingdom, France, the Netherlands and Luxembourg granted remarkably high numbers of type approvals in 2014. Nearly all French OEMs, like Citroen, Peugeot and Renault as well as Dacia, which manufactures in Romania but belongs to Renault, worked with the French type-approval authority solely. This might have been encouraged by the strong collaboration between the French Automobile Manufacturers' Association and UTAC CERAM, the only designated technical service in France. The type-approval authority in the United Kingdom, VCA, and the type-approval authority in the Netherlands, RDW, share an exceptional standing: both organisations are type-approval authority and technical service at the same time and can also designate or refuse designations of other technical services in the respective national market. VCA promotes this fact in their marketing materials: *"VCA is a combined Approval Authority and Technical Service, which will help you to get your products to market quickly."*[34] Nevertheless, the type-approval authority does have the possibility of controlling or reviewing the technical service. Under the circumstances explained above, a close look needs to be taken at the motivation to do so and the monitoring mechanism of the type-approval authority. The type-approval authority would have to review another department of the same organisation and again. A conflict of interests could arise, given that both VCA and RDW are substantially or even fully funded by the processing type approvals, as mentioned earlier. The reasons for the high number of type approvals granted in Luxembourg cannot be fully understood. However, it is reasonable to assume that a combination of the reasons previously mentioned in chapter 4.1 is decisive for the high numbers of type approvals in Luxembourg (short processing period, low frequency and intensity of post-CoP audits, low rate of reviews of the test results processed by the technical service and low type approval costs for OEMs).

[34] See VCA (2016a), p.4

Figure 5: Shares of passenger car production and granted type approvals per EU MS in 2014



Source: Own illustration based on EEA (2016) and ACEA (2015)

4.4. Conformity of production

In addition to the initial CoP assessment, the concluding CoP and the continuous CoP must be verified. However, both can be interpreted differently by the national type-approval authorities. The continuous CoP is an ongoing process. KBA, the German type-approval authority, for example, is one of the most important type-approval authorities on account of its high number of type approvals in the EU and rarely takes production samples to verify conformity. However, type-approval authorities usually do not have the financial or staff resources or the testing infrastructure (with the exception of VCA or RDW) to conduct physical testing and are thus compelled to commission a technical service. *"The sole existence of ISO standards seems not to be sufficient to fend off an audit by the type-approving type-approval authority. In the case of a so called CoP audit, the type-approval authority conducts inspections at the manufacturer's facilities at more or less regular intervals. In most cases, the type-approval authority visits the manufacturer and requests a physical inspection of the CoP documentation to check if the manufacturer conducts the tests himself, if the documentation is still valid and if the quality management system is still in operation. CoP audits are conducted by the type-approval authority or a designated technical service on behalf of the type-approval authority. Physical CoP audits including the inspection of vehicle samples directly taken out of the production by the type-approval authority occur very rarely in practice."* (Volker Noeske, DEKRA). *"The CoP-standards are implemented in varying quality throughout the EU, a stronger shift to in-use testing is necessary."* (Peter Mock, ICCT)

4.5. In-service conformity

The required testing is carried out exclusively in the laboratory, in accordance with the NEDC. There is no testing under real-world driving conditions following the example of the far more detailed and realistic testing of heavy duty vehicles, including PEMS testing, and none of the data referring to the ISC process is made public.

Additional voluntary market surveillance programmes in Germany and the United Kingdom have been terminated. The last programme still operating in the European Union is underway in Sweden.[35] Market surveillance programmes are expensive. Any Member State that decides to finance such a programme is confronted with the fact that, if any discrepancies or cases of non-compliance are revealed, it has no legal right to take proper action. This MS can merely prevent the sale of a model within its territory temporarily if a "serious" safety or environmental issue is identified. According to the current law in force, only the type-approval authority that granted the type approval is allowed to take action, e.g. recall vehicles or impose a fine on OEMs for non-compliance. In this respect, another conflict of interest might arise, especially because type-approval authorities that are technical services at the same time would have to start an investigation within their own organisation. The driving force for a comprehensive investigation would be missing. Besides, independent re-testing by a third party is not even possible at the moment, as the OEM does not make public the necessary information regarding the test settings of the vehicle, e.g. road load coefficients.

[35] See STA (2016)

5. STATUS-QUO OF PENALTY EXECUTION AT MS LEVEL

KEY FINDINGS

There is a lack of consistency in the penalties at MS level in the EU. They range from financial sanctions, frequently combined with partial or full annulment of TA, all the way to imprisonment

The EU needs to further adjust the penalty provisions for the MSs.

So far, no cases are known within the EU where OEMs have been sanctioned because of infringements listed in 715/2007/EC (Art. 13, par. 2).

The implementation of penalties is regulated in (EC) Regulation No 715/2007 (Art. 13). Art. 13 par. 2 lists a number of examples of the types of infringements subject to penalties:

- **making false declarations during the approval procedures or procedures leading to a recall;**
- **falsifying test results for type approval or ISC;**
- **withholding data or technical specifications which could lead to a recall or withdrawal of type approval;**
- **use of defeat devices;**
- **refusal to provide access to information;**

The MSs must lay down their penalty provisions that are applicable to infringing OEMs. The penalties must be effective, proportionate and dissuasive and the MS must make sure that they are implemented. MSs were obliged to notify the EC of penalty provisions by 2 January 2009.

Nearly all MS have replied with respect to the implementation of penalties regulated in Directive 2007/46/EC (Art. 46) and in (EC) Regulation No 715/2007 (Art. 13). The EC is currently in the process of translating and analysing the replies. Once this analysis has been completed, a table showing the national measures and, if possible, the information will be made public.[36] According to an earlier document - an additional analysis complementing the EC's impact assessment on the review of the type-approval Framework Directive 2007/46/EC[37] - where all MSs were asked in a questionnaire about the national implementation of penalties, only 18 MSs (and Norway) have reported back.

The above referenced questionnaire has revealed that MSs have different forms of penalties. The sanctions most frequently mentioned are fines. In Romania, for example, EUR 6 750 must be paid per affected vehicle. Different amounts are mentioned, but in most cases it is unclear whether the fee is payable for each vehicle or whether the OEM is guilty of a criminal charge. In Spain, for example, a penalty of up to EUR 600 000 is payable. The assumption is that this amount is a one-time fee for the OEM in charge. Financial sanctions are often combined with partial or full annulment of the type approval.

[36] According to information from the EC, DG for Internal Market, Industry, Entrepreneurship and SMEs, 26 May 2016.

[37] See EC (2016), p. 48ff.

There appears to be a need for the EU to further adjust the penalty provisions. With financial sanctions, for example, it is unclear whether the MSs were expected to report fees per registered vehicle in their territories or a general criminal charge for the OEM.

When asked which measures the relevant authorities in the MSs have taken to launch the necessary investigations at national level with regard to type approvals that had been granted to the vehicles concerned, as identified by Volkswagen, many MSs reported that they had not undertaken any steps as they had not been involved in the type approval for these cars and are still waiting for further information. Other MSs contacted KBA and/or Volkswagen or the local Volkswagen importers.

Finally, Commission Services do not have any knowledge of cases involving the execution of penalties under Article 13 (EC Regulation No 715/2007) by a MS.[38]

Withdrawals as the one currently implemented on account of the recent discovery of the "thermal window" during KBA's investigation of "Volkswagen" occurred before though. The thermal window is another way to tweak engine performance as a means to increase emission levels. With passenger cars that start up at very cold ambient temperatures there is the risk of condensation building up in their catalytic converters and engines, which could cause rust. "*Switching off or throttling back emissions treatment systems, however, has the added benefit of improving engine performance and stretching the interval between refilling vehicles with urea, a substance needed to extract NO_x from exhaust fumes*."[39]

[38] According to information from the EC, DG for Internal Market, Industry, Entrepreneurship and SMEs, 26 May 2016.

[39] See Reuters (2016)

6. EMISSION MEASUREMENTS IN THE CONTEXT OF THE EU TYPE-APPROVAL PROCESS

KEY FINDINGS

Many measurement regulations are developed, specified and therefore heavily influenced by industry players.

The NEDC has many weaknesses. Originally, the cycle was not designed to reflect real driving conditions. Only a few requirements are defined for the OEMs and this leads to vehicle optimisation on the test bench. The conventional testing methods (used in the type-approval process) are unable to detect illegal defeat devices.[40]

The WLTP test cycle should provide more accurate predictions of exhaust emissions and fuel consumption under real-world driving conditions.

Going by the current status of the negotiation process, around 95 % of all driving conditions will be covered during RDE testing.

To ensure that the vehicles comply with all the relevant driving conditions, ISC measurements by independent laboratories are of crucial importance.

Over the past 20 years, measurement programmes in the HBEFA group have been funded by the original HBEFA member countries. No EU money has been involved except in the ARTEMIS project from 2002 to 2007, which was funded by the European EC as part of the 5th Framework Research Programme.

This chapter explains the need for test cycles, the NEDC as the current type approval test cycle and the future emission measurement procedure (WLTP in combination with RDE).

All regulations specifying the vehicles measurements that need to be carried out in the course of the type-approval process, whether EU legislation or UNECE legislation, are drafted in numerous technical working groups. At UNECE level, three agreements, adopted in 1958, 1997 and 1998, provide the legal framework allowing contracting parties attending the WP.29 sessions (World Forum for Harmonization of Vehicle Regulations) to establish regulatory instruments concerning motor vehicles and motor vehicle equipment. Issues regarding pollutant emissions from motor vehicles (including test procedures) are discussed in the Working Party on Pollution and Energy (GRPE). At EU level, these topics are discussed in the Technical Committee on Motor Vehicles (TCMV) which is a committee of the EC. The members are delegates from the EU MS. The Motor Vehicle Emission Group (MVEG) does the coordination. These working groups are divided into further technical sub-working groups that are responsible for different topics, of which members should have a high technical understanding. OEMs have been involved in policy making at EU level because of a lack of internal expertise in the EC and the MSs as a result of the limited budgets. ACEA and the OEMs have taken it upon themselves to staff all the technical working groups with a large number of representatives. As a consequence, OEMs have a strong lobby and influence the EU regulatory process. In reality, ACEA has taken on the role of stakeholder rather than technical expert. Especially at UNECE level, OEMs have an even stronger presence and weight

[40] See KBA (2016), p.8; p.123 ff.

when it comes to policy making. The fewest MSs have the necessary competences or budgets to allow them to participate in these meetings around the world.

As a consequence, most of the group members are representatives of the automotive industry. Furthermore, a lack of funding is the reason why employees of type-approval authorities or other independent measurements institutions do not participate.

6.1. The need for driving cycles

New vehicles must comply with emission standards (EURO classes) for their approval and registration. Since the 1990s, new passenger cars have had to pass what is known as the NEDC to obtain type approval for the European market.

A driving cycle specifies under what conditions and speed curves a vehicle must be operated in order to measure emissions and fuel consumption. In this test cycle, the vehicle follows several sequences of defined acceleration and deceleration points. The permissible total emissions of various air pollutants must not be exceeded during the test. The driving cycle is performed on a roller test bench, where the vehicle's exhaust emissions are collected and analysed to assess the emissions rates. A well-trained driver follows the driving cycle on the roller test bench and makes sure that the driven cycle is as close to the defined cycle as possible. The benefit of a standardised test cycle in a laboratory is its repeatability and the straightforward comparability of the test results.

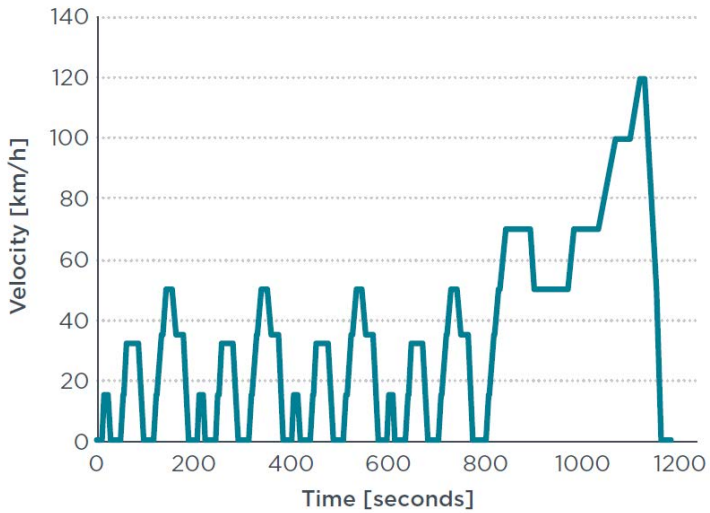
6.2. The NEDC and its original purpose[41]

The NEDC dates back to the end of the 1960s when Germany and France decided on exhaust standards for the first time. This resulted in the common driving cycle of Directive 70/220/EEC of March 1970. As a result of the oil crisis, a first method to measure fuel consumption designed by the United Nations Economic EC for Europe followed in 1976, which was transposed into DIN standard 70030 in 1978. This driving cycle already comprised a simulation of urban traffic and consistent speeds of 90km/h and 120km/h, coming very close to the test cycle still being used today. In 1992, the simulation of urban traffic based on DIN standard 70030 was finally transposed into Directive 70/220/EEC, marking the beginning of the NEDC. Emission standard EURO III added the cold-start element to the NEDC: the measurement of the car, which is pre-heated to approx. 25°C, starts immediately and not after 40 seconds, as was previously the case. With the introduction of exhaust standard EURO 5, Directive 70/220/EEC was repealed by Regulation 715/2007.

When determining a vehicle's emissions, the first step is to identify the vehicle's rolling and air resistance on the road using a roller test bench. Then the vehicle is parked at an ambient air temperature of 20°C to 30°C. After six hours it undergoes the actual test cycle, which lasts 1 180 seconds, i.e. about 20 minutes. In this cycle, urban conditions are simulated two thirds of the time and extra-urban conditions are stimulated one third of the time at an average speed of 33.6km/h and with the gear positioned in neutral for about 23.7% of the time. Figure 5 shows the speed curve the vehicle must follow in the NEDC within the given time frame.

[41] See AK Vienna (2015)

Figure 6: NEDC according to 70/220/EC



Source: ICCT (2014)

The NEDC has many weaknesses. It originally was not designed to reflect real driving conditions, since velocities beyond 120 km/h are not recorded and unrealistically low acceleration behaviour is applied. Furthermore, only a few requirements are defined for the OEMs, which has lead them to optimise the vehicles on the test bench. As a result, the emission behaviour of the mass-production vehicle during road use is not reflected. Some examples of this effort to optimise are:

- **overinflating the tyres to reduce rolling resistance;**
- **taping over indentations or protrusions on the body to reduce aerodynamic drag;**
- **disconnecting the alternator;**
- **altering wheel alignment and camber inclinations;**
- **minimising vehicle weight;**
- **optimising the engine map;**

6.3. The need for a new driving cycle – WLTP

The above mentioned weaknesses require a new, more realistic type approval test cycle. Moreover, recital 15 of Regulation (EC) No 715/2007 states that:

"The EC should keep under review the need to revise the New European Drive Cycle as the test procedure that provides the basis of EC type-approval emissions regulations. Updating or replacement of the test cycles may be required to reflect changes in vehicle specification and driver behaviour.

The WLTP was developed in a programme launched by the UNECE World Forum for the Harmonization of Vehicle Regulations (WP.29) through the Working Party on Pollution and Energy (GRPE).[42] The purpose of this project was to develop a globally harmonized driving

[42] See UNECE (2013)

test cycle for light duty vehicles with typical driving characteristics. This cycle was to serve as the basis for a legislative, globally harmonized type certification test from 2014 onwards.

The WLTP test cycle was developed on the basis of "real-world" driving data taken from five different regions, including the EU and Switzerland, the US, India, Korea and Japan. It covered a wide range of vehicle categories (M1, N1 and M2 vehicles[43], various engine capacities, power-to-mass ratios, OEMs, etc.) on different road types (urban, rural, motorway) and under different driving conditions (peak, off-peak, weekend).

Unlike the NEDC, the WLTP test cycle is longer (both in time and distance), much more dynamic, the average and maximum speed is higher, it has more acceleration and braking sequences and all these parameters vary for the three vehicle categories (power-to-mass ratio). The WLTP test cycle should thus be more accurate in predicting the exhaust emissions and fuel consumption under real-world driving conditions. Plans are to replace the NEDC with the WLTP test cycle in 2017. The differences between NEDC and WLTP test cycle are shown in Table 7.

Table 7: Differences between NEDC and the WLTP test cycle

	Unit	NEDC	WLTC
Duration of cycle	[sec]	1 180	1 800
Length of cycle	[km]	11.03	23.27
Average speed	[km/h]	33.6	46.5
Maximum speed	[km/h]	120.0	131.3
Neutral share	[%]	23.7	12.6
Constant drive share	[%]	40.3	3.7
Acceleration share	[%]	20.9	43.8
Deceleration share	[%]	15.1	39.9

Source: ICCT (2014)

6.4. The need for a new test procedure – RDE

Because the emissions generated by real on-road driving of EURO 5 and 6 diesel vehicles vastly exceed the emissions measured in the regulatory NEDC, the EC set up a working group in January 2011 that was open to all interested stakeholders for the purpose of developing a RDE test procedure that better reflects emissions measured on the road. For this purpose, the EC followed the technical option provided in Regulation (EC) No 715/2007, which entails the use of PEMS and Not-To-Exceed (NTE) limits. Therefore, a conformity factor is used as a multiplier by which the originally agreed Euro 6 limits are allowed to be exceeded.

RDE tests will assist the laboratory-based procedure, ensuring that the emission levels of NO_x emissions measured during the laboratory test are confirmed under real driving conditions. This means that the car will be driven outside and on real roads according to random acceleration and deceleration patterns.[44]

[43] M_1 are vehicles used for the carriage of passengers and comprise no more than eight seats in addition to the driver's seat (passenger car); M_2 are vehicles used for the carriage of passengers, comprise more than eight seats in addition to the driver's seat, and have a maximum mass not exceeding 5 tonnes (bus); N_1 are vehicles used for the carriage of goods and with a maximum mass not exceeding 3.5 tonnes (pick-up truck).

[44] See EC (2015a)

Box 1: Status of RDE implementation

"The RDE measurement with PEMS as part of the type-approval process will be implemented in four legislation stages. The four stages are divided into the Transitional Phase (until September 2017), Step I Type Approval (by the end of 2019), Step II Type Approval (by the end of 2021) and Step III (from 2022) for revision and modification.

The finalisation of the legal text is foreseen in four packages. The first two packages have already been adopted in technical working groups wherein the measurement methods, the requirements for the measuring equipment and some boundary conditions (height meter, average speed, minimum and maximum speed, dynamic parameters etc.) and the evaluation methods have been set. In the third package the methods for light duty vehicles, hybrid electric vehicles, cold start and other open issues shall be fixed, in the 4th package the ISC has to be defined." (Stefan Hausberger, TU Graz)

Given the technical limits to improving the real emission performance of currently produced diesel passenger cars in the short-term, MSs have agreed on what has been termed "conformity factors" in a two-step approach:

- **in a first step, OEMs will bring down the discrepancy to a maximum conformity factor of 2.1 (i.e. 110 % above the EURO 6 limit) by September 2017 for new models (by September 2019 for new vehicles);**
- **in a second step, this discrepancy will be brought down to a factor of 1.5 (i.e. 50 % above the EURO 6 limit) by January 2020 for all new models, giving due consideration to technical margins of error (by January 2021 for all new vehicles);**[45]

The definition of the boundary conditions under RDE testing will be crucial. It must be noted that existing exhaust gas after-treatment systems are able to meet emission limits quite in line with the EURO 6 standard under RDE testing.

Box 2: Prospects of recent RDE legislation

"RDE tests are capable to cover the full range of relevant driving behaviour and ambient conditions, thus the vehicle must have low emissions in all relevant driving conditions. About 95 % of all driving conditions will be covered during the RDE testing part according to the current status of the negotiation process. Due to the RDE legislation manufacturers have to massively adjust and improve design and control of emission control technologies in the development process of the vehicles. Due to the broad range of possible driving conditions, manufacturers may test the vehicles quite "soft". To ensure that the vehicles comply with the regulations in all relevant driving conditions, ISC measurements by independent laboratories are of the utmost importance." (Stefan Hausberger, TU Graz)

6.5. The need for independent measurement laboratories

At the end of the last century, many MSs showed up major discrepancies between the immission situation detected at air quality stations and the calculated emissions from pollutant sources. These discrepancies were particularly conspicuous at roadside located measurement stations. The air quality close to roads has not declined to the extent expected on the basis of emission-limiting legislation.

[45] See EC (2015b)

Therefore, as early as in the 1990s, a handful of independent measurement laboratories[46] and environment agencies[47] made it their responsibility to perform independent emission tests. They had realised that vehicles produce considerably greater amounts of emissions on more realistic real-world driving cycles (e.g. in the Common Artemis Driving Cycle (CADC) or ERMES driving cycle) than on the NEDC.[48] The first programmes on real-world emissions, such as the ARTEMIS project, concentrated on EURO 2 and 3 vehicles. Since the beginning of 2000, there has been clear evidence that emission factors derived from TA measurements using the NEDC are not representative of the real-world driving emission behaviour of modern vehicles. This was particularly the cases with NO_x and PM emissions from diesel vehicles (see chapter 6.6).

It should be noted that these higher, but more realistic, emission factors are taken from miscellaneous European emission inventory guidebooks for air emission inventory compilers[49] in the EU.[50] As a consequence, all MSs calculate their air emissions inventories on the basis of realistic emission factors and not on the basis of type approval limit values. Some MSs calculate vehicle emissions using COPERT[51] (COmputer Program to calculate Emissions from Road Transport), other MSs have their own models that apply HBEFA emission factors, for instance, and the remaining MSs directly apply real-world default values given in the guidebooks.

Box 3: The history of HBEFA

"Given these circumstances plus the need for robust emissions factors for the national emission inventories of the MS, the HBEFA group[52] for example was founded with the aim to generate robust emission factors for road vehicles. Originally, the HBEFA was commissioned by the environment agencies of Switzerland, Austria and Germany in the 1990s, because 'information on specific emissions is needed, i.e. of individual vehicles' in order to determine the extent, development trend and potential reduction of traffic-related emissions. Over the past 20 years, measurement programs in this group were principally funded by above mentioned countries. No EU money was involved. There was only one exception where the EC participated, namely in the ARTEMIS project (running from 2002 to 2007). By now, the HBEFA group is supported by more countries such as Sweden, Norway and France. Since 2007/2008 the JRC has chaired the group. Now this group works in parallel as the so called European Research for Mobile Emission Sources (ERMES) group. Measurement programs are still being developed and financed only from the original HBEFA member countries. As long as ERMES is not provided with a base funding, the group is not as powerful as it could be." (Mario Keller, HBEFA group)

The above-described development caused the testing results of pollutant emissions in the NEDC, as required under the framework of the type-approval process, and the creation of real-world emission factors on the basis of driving cycles like CADC or ERMES used for

46 TUG, EMPA, AVL-MTC, TNO, LAT (INFRAS without test bench)

47 BAFU CH, UBA D, Environment Agency Austria

48 See Hausberger, S. (2010)

49 Emission inventory guidebooks such as EMEP (Monitoring and Evaluation Programme) or CORINAIR (Core Inventory Air emissions).

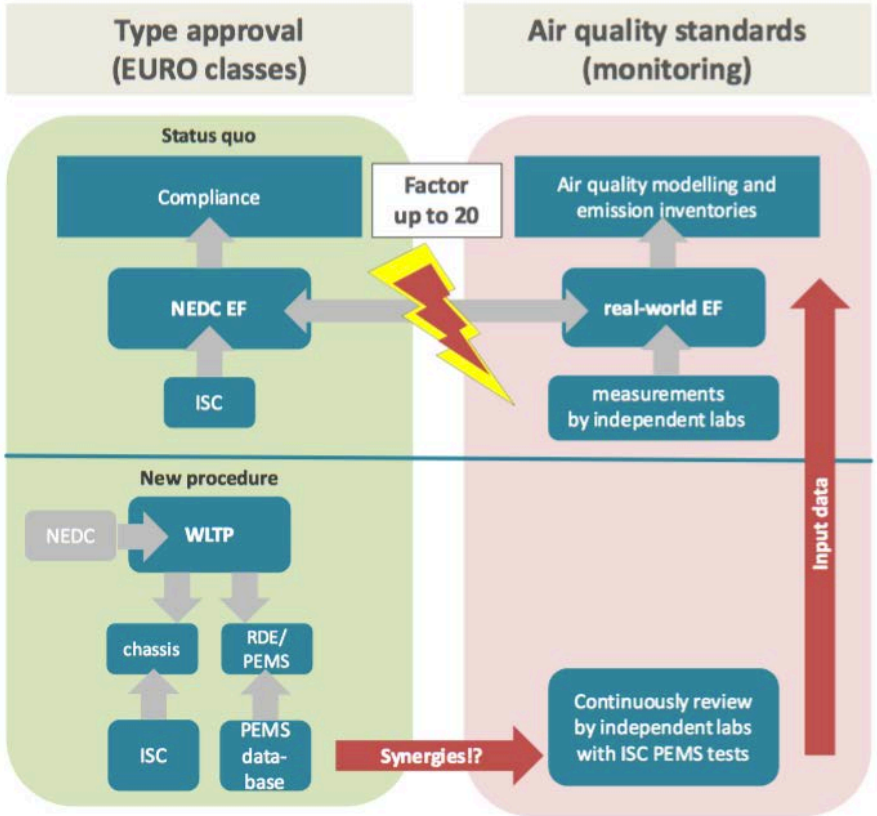
50 See EEA (2016b)

51 Results of vehicle emission measurements tested using the CADC are incorporated in the real-world road transport emission models, such as COPERT.

52 HBEFA provides emission factors for the most common vehicle types (passenger cars, light-duty vehicles, heavy-duty vehicles, urban buses, coaches and motor cycles), differentiated by emission concepts (Euro 0 to Euro VI) and by various traffic situations. HBEFA provides emission factors for all regulated and some important unregulated pollutants, including fuel consumption and CO_2. Following several updates, the most recent version (Handbook 3.2) was published in July 2014.

emission inventories and air quality modelling in the road transport sector to drift apart. Once the WLTP has been introduced, especially the RDE part (with PEMS measurements on the road), the future will see the establishment of a third category of emission factors. These RDE emission factors will reflect the current air quality most realistically. Figure 7 illustrates the emission regulations within the EC type approval framework, on the one hand, and represents the basis of air quality standards, on the other.

Figure 7: Comparing type approval emission regulations and air quality standards



Source: Environment Agency Austria (2016)

Today, for a vehicle in the EU to obtain type approval, NO_x emissions measured in the NEDC must comply with the type approval limit values of a specific emission standard. In other words, the measured NO_x emission factors in the NEDC must be lower than the type approval limit value. As the NEDC is also the mandatory driving cycle in ISC testing, ISC testing is currently unable to identify any discrepancies in emissions. Independent laboratories measure NO_x emissions in parallel with more realistic test cycles, such as the CADC and the ERMES test cycle on test benches. The emission factors generated in this manner are higher than the emission factors resulting from the NEDC within the type-approval process and they are also used for national emission inventories and air quality modelling, which explains why the two worlds of type approval and air quality drifted apart.

With EURO 6 diesel passenger cars, for example, emission factors measured under real driving conditions exceed the type approval limit value by a factor of up to 20.[53] The WLTP, which includes RDE testing – in addition to chassis dyno emission tests on a test bench – and which is set to replace the NEDC in the future, is able to connect these two "emission test regimes", as shown in Figure 6 above. The usability of test emission data for regional and

[53] See KBA (2016)

national emission inventories as well as for air quality modelling will largely depend on whether RDE driving conditions during type approval represent real conditions, i.e. ambient conditions (e.g. temperature, altitude), driving style (e.g. acceleration, top speed), road type and traffic situations. The definition of RDE testing will also be key to determining whether the emission test in the scope of the new test procedure can provide realistic, trustworthy and reproducible emission values.

The RDE emission factors generated in the type-approval process with PEMS measurements made under real on-road driving conditions should be recorded in a PEMS database and serve as input data for the improvement of air quality modelling coordinated by independent laboratories who are already collecting emission factors generated in several PEMS measurement projects throughout the EU.

6.6. Communicating the emissions discrepancy

Initial studies on the discrepancy of NO_x emissions produced by vehicles were published from 2000 onwards, including the study on the emission behaviour of heavy-duty vehicles[54]. In other words, this discrepancy in vehicle emissions was certainly known in the community of experts. Even if the EC is not sufficiently staffed with technical experts on vehicle emission measurements, at least the results of the ARTEMIS project – with participation of the EC – must have been known.

Box 4: Communication between the EC and the MS based on the example of Austria

In accordance with Art. 8 (2) of the NEC Directive 2001/81/EC (NECD), every MS was obliged to submit a programme of measures to the EC (DG ENV) in 2002.

In this report, Austria already noted that vehicle emissions are higher than expected on the basis of the type approval and that this divergence would make compliance with the emission ceilings difficult.[55]

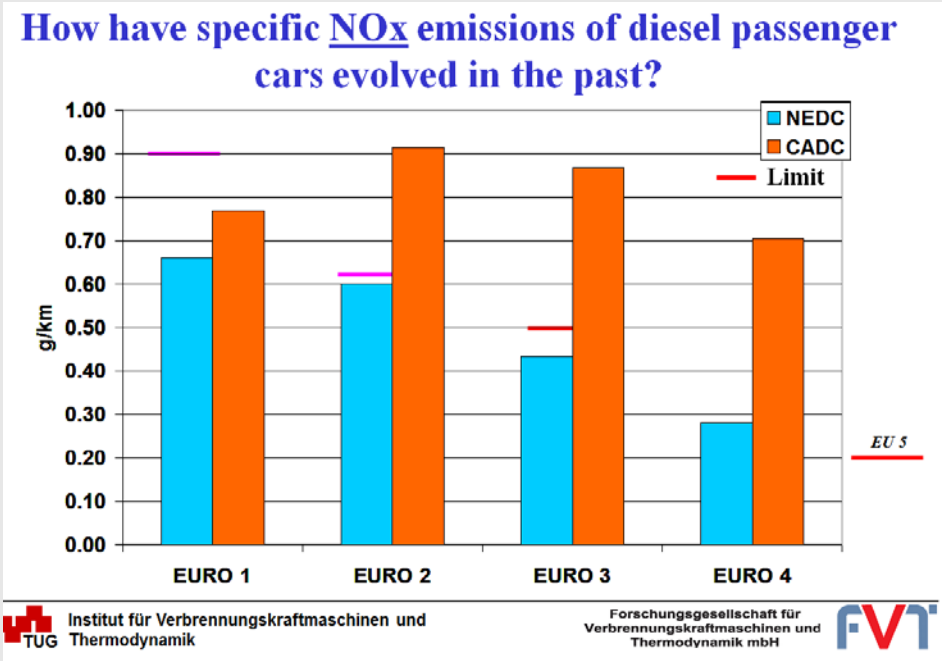
In accordance with Art. 8 (2) of NEC Directive 2001/81/EC (NECD), every MS was obliged to submit an updated programme of measures to the EC (DG ENV) in 2006.

Austria clearly pointed out this divergence in this report. The problem was identified and quantified more clearly.[56] Austria also reported these findings in 2010 when it submitted a request to the EC asking for extension of the NO_2 deadline.[57]

Box 5: Communication between the EC and independent laboratories/NGOs

As early as during a hearing for European OEMs during the Austrian Council presidency in Brussels in 2006 (February 2), Stefan Hausberger (TU Graz) presented NO_x emission measurement results that exposed the discrepancy between NO_x emissions measured in the NEDC and the Common Artemis Driving Cycle (CADC), which represents real-world driving more accurately.[58]

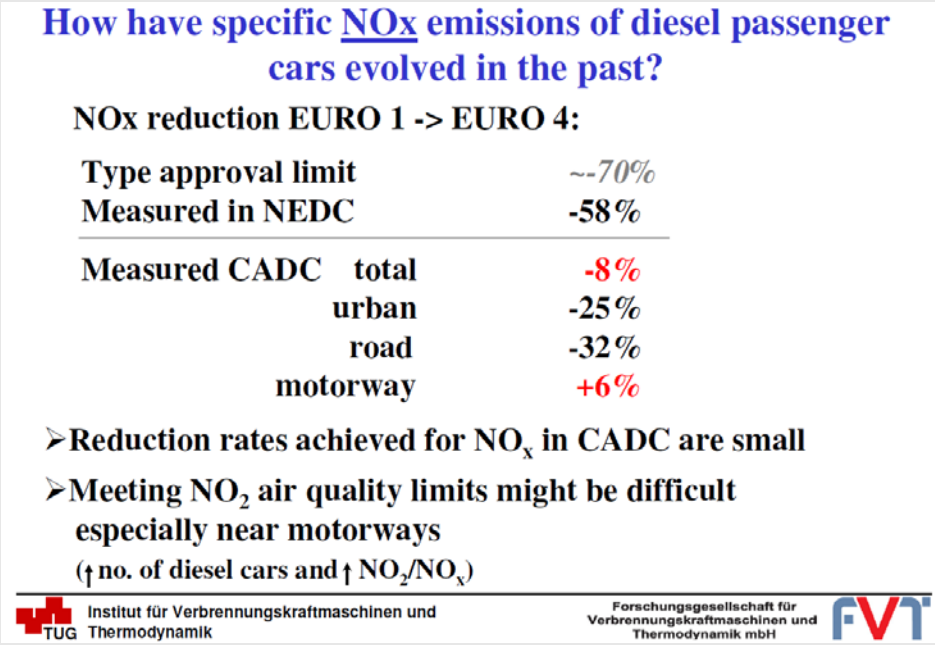
[54] See Hausberger, S. et al. (2003)
[55] See BMLFUW (2002), p.6 at the top, p.12 at the top
[56] See BMLFUW (2006), Executive summary para. 3; p.9; p.18 at the top; p.20; p.26; p.27
[57] See BMLFUW (2011)
[58] Hausberger, S. (2006)



Source: TU Graz (2006)

According to measurements in the NEDC, the improvement in NO_x emissions between EURO 1 and EURO 4 diesel passenger cars should have amounted to minus 58 %. As a matter of fact, measurements in the CADC showed that NO_x emissions decreased only by 8 %, as can be seen in the figure below.

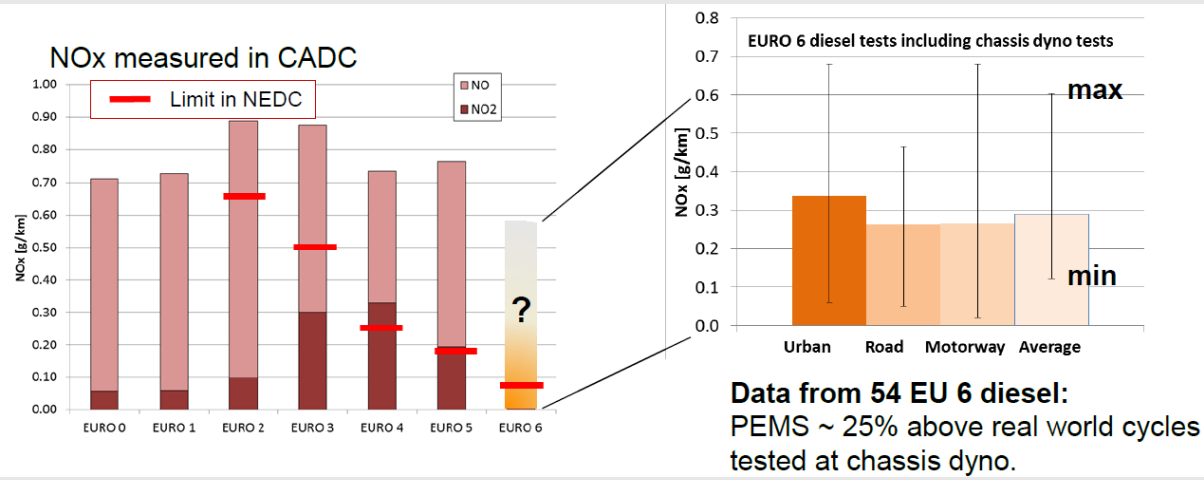
The ICCT also communicated these findings to the former vice-president of the 27-member Barroso Commission (Barroso I), Günter Verheugen (see letter dated 3 September 2007).[59]



Source: TU Graz (2006)

[59] ICCT (2007)

The figure below shows the current situation regarding type approval emission limits and the measured real-world emissions in the CADC. As the measurement database for EURO 6 diesel passenger cars is still limited and currently shows a wide range from 50 milligrams (mg)/km up to 700 mg/km, there is still need to further investigate the real driving emission behaviour of EURO 6 diesel passenger cars.



Source: TU Graz (2016)

7. CONCLUSION AND POLICY RECOMMENDATIONS

This chapter describes the most important conclusions and recommendations based on the findings of this study, including the stakeholder consultation (see chapter 4) and other related studies.

7.1. Stakeholder conclusions

- **Conclusions regarding the existing legislation.**
  - Type approval regulations should be clearer and more precise to leave less room for the interpretation of EC provisions, especially the interpretation of specific technical provisions.
  - A more precise definition of legal obligations for each stakeholder is needed. For example, the regulation fails to provide any explicitly defined intervals for CoP inspections at the OEM by the type-approval authorities.
  - Separate regulatory acts on exhaust emissions should be adapted in such a manner as to induce technical services to conduct tests in their own or in independent third party laboratories. The possibility of "in-house-testing" at the OEM's facilities under the supervision of a technical service should be critically re-examined.
  - Consistent quality standards regarding type-approval authorities' working processes should be ensured by specifying the legal framework, especially the separate technical regulatory acts (to the extent possible, as it will never be possible to cover all future developments in the automotive industry with technical provisions).
  - The legal framework, especially the separate technical regulatory acts that define the activities of the technical services, must be clarified in order to minimise room for interpretation; a clear definition should be provided to determine what is legal and what is not and harmonised quality standards must be set.
- **Conclusions regarding practical implementation within the type-approval process.**
  - Transparency should be ensured for the whole type-approval process.
  - Consistent quality standards regarding type-approval authorities' staff should be ensured (in terms of manpower and technical expertise).
  - Commercial competition between the type-approval authorities should be banned and funding schemes for the type-approval authorities should be set up by the EU MSs (e.g. by charging a fee for every new passenger car sold or registered).
  - The activities of technical services should be detached from the OEM's development, production and distribution processes for all parts or systems related to passenger cars to ensure entirely independent testing by the technical services.
  - Testing should be carried out at independent testing facilities detached from the manufacturing plant of the OEM and conducted by category A technical services only; in case of testing by category B technical services, a predetermined mandatory share of testing at external testing facilities should be ensured.

- The commercial relationship between technical services and OEMs should be banned by transferring the responsibility for the ordering process to the type-approval authority, for example (commissioning, payment, etc.).
- Any kind of economic relationship between the type-approval authorities and the technical services should be banned (as has been done in the United Kingdom, in the Netherlands and partly in France).
- Consistent application of high quality standards should be ensured for CoP verification throughout all type-approval authorities of the EU.
- All European type-approval authorities should reach the same operating level. The fees and charging systems and the processing periods of all type-approval authorities should be harmonised (e.g. by stipulating a minimum processing period that is long enough to ensure a high quality review).

- **Conclusions regarding exhaust emission and verification testing.**
  - A more precise and representative definition of testing with a focus on on-road testing is needed.[60] The introduction of RDE legislation is an important step in this direction, but *"[…] so far it is restricted to a limited number of air pollutants and vehicle types, and it is still based on prototype vehicles, with the testing process largely under control of the manufacturers themselves."*[61]
  - "*Introducing regional specifications beyond WLTP would allow EU regulators to go a step further – for example by defining ambient test temperature that is closer to the average temperature in the EU than for WLTP*."[62]
  - In principle, the new WLTP measurement procedure and the prospective RDE measurements are a step in the right direction. However, it would be recommendable to introduce a well-functioning EU-wide ISC programme that includes mandatory RDE testing. This should also include good coordination between all countries and laboratories regarding the test measurement programmes.[63]
  - The detection of illegal defeat devices should be achieved by having tests reflect conditions that approximate reality.[64]
  - ISC testing with PEMS should be distributed over several independent laboratories to ensure that ISC becomes an EU-wide activity. The budget for these activities could be provided by all MSs or another possibility would be for the OEMs to set up a fund.[65]
  - Better cooperation between environment ministries/ air quality authorities and type-approval authorities is needed. This would include clearly defined roles and contacts in all the authorities.[66]
  - Authorities should make measurement results publicly available (via database or as short reports, optionally with restricted access for measurement

[60] See ICCT (2015), p.29
[61] See ICCT (2015) p.30
[62] See ICCT (2015) (2015), p.29
[63] Stefan Hausberger, TU Graz
[64] See ICCT (2015) (2015), p.29
[65] Stefan Hausberger, TU Graz
[66] Stefan Hausberger, TU Graz

community). It would be highly desirable to obtain vehicle-related type approval data (including road load values and masses, to verify CO_2 values).

- Transparency within the ISC process should be enhanced by publishing information about the numbers and types of passenger cars tested, testing parameters (such as road load coefficients), the performance of passenger cars during the tests, reasons for rejection, etc., in an online register that can be accessed by third parties.
- A funding system should be set up to enable all EU MSs (also those without revenues from type approvals) to conduct market surveillance, for example by charging a fee for each new vehicle sold and distributed by a centralised authority at European level.
- Re-audits during production (CoP), in the market (market surveillance) and for vehicles in operation (ISC) should be intensified.[67]
- The standards for re-audits (identical qualitative and quantitative conditions) should be harmonised across Europe to avoid competition between the type-approval authorities.[68]
- A strong emphasis needs to be placed on independent conformity testing. U.S. authorities, for example, enjoy far-reaching executive powers which they have exercised on a regular basis to issue sanctions or recall different vehicle models.[69]

Apart from improvements in the legislation and the practical implementation of the type-approval process, the stakeholders also mentioned possible organisational changes, including:

- the installation of a centralised type-approval authority at EU level,
- the installation of a supervisory board at European level that is endowed with enforcement powers allowing it to impose sanctions or
- restructuring the type-approval process based on the US example where testing is done by the OEM and powerful agencies like the Environmental Protection Agency (EPA) do intensive reviewing and retesting.

7.2. Recommendations

The following recommendations are based on the results of this study and the stakeholder consultation (see chapter 4):

- **Streamlining existing legislation and regulations.**
  - To provide a clear structure with well-defined responsibilities for the MSs, type-approval authorities, OEMs and technical services with specific competences.
  - To support and strengthen the exchange of knowledge regarding standards and implementation of the relevant legislation between type-approval authorities in a bid to harmonise the type-approval process.
  - Technical services could be commissioned by the type-approval authorities, not by the OEMs, to reduce the conflict of interest arising from the commercial

[67] See ICCT (2015), p.29
[68] See ICCT (2015), p.29
[69] See ICCT (2015), p.29

relationship. Preference should be given to category A technical services with their own testing facilities and related experience.

- **Switching from the NEDC to the WLTP test cycle.**
  - From 2017 onwards, the Worldwide Harmonized Light Vehicle Test Procedure (WLTP) will be mandatory for emission testing. The most important part in the procedure will be the RDE test, which includes what are termed Not-To-Exceed (NTE) limits. Therefore, a conformity factor is used as a multiplier by which the originally agreed EURO 6 limits are allowed to be exceeded. It is crucial to clearly specify and provide adequate definitions of the boundary conditions in the emission test that represent real-world driving conditions in the EU.
  - Conformity factors for emission limits have been introduced to allow vehicles to emit higher emissions in real-world driving situations. The WLTP "*requires the real driving emissions from cars and vans to be lower than the legal limits multiplied by a 'conformity factor'. This factor expresses the ratio of on-road PEMS emissions to the legal limits. At the time of writing, the NO_x conformity factor has been set to 2.1 (i.e. 110 % above the EURO 6 limit) from 1 September 2017 for new models and two years later for all new vehicles. In a second step, it will be reduced to 1.5 (i.e. 50 % above the EURO 6 limit) from 1 January 2020 for new models and one year later for all new vehicles*."[70] These conformity factors should be eliminated over time as existing technology already has the ability to reduce emissions to the emission limits in nearly all driving situations and boundary conditions.
- **Performing ISC tests organised and prepared by independent bodies and test laboratories.**
  - To have vehicle emissions re-tested by independent organisations, such as environmental agencies and independent laboratories, using PEMS in real driving boundary conditions that are representative for normal vehicle use in Europe.
  - To ensure funding through a small registration fee in a bid to finance ISC in a manner that guarantees representative emission testing for the European vehicle fleet.
  - To have the OEMs publish the test results for vehicles as well as vehicle test settings.
- **Imposing clear sanctions on OEMs that fail to comply with emission legislation at EU level.**

Independent ISC re-testing and the publication of the results, in particular, will give rise to a situation where OEMs are keen to ensure the proper functioning of emission abatement systems under real driving conditions. As a result, OEMs will strive to optimise their exhaust gas systems on the basis of real driving conditions and not in emission test situations on test benches.

Moreover, the situation described above will reduce the need of MSs and type-approval authorities to acquire substantial technical experience and to finance this capacity-building effort, which is very cost-intensive, especially in the automotive sector, which is characterised by rapid technical development and change.

[70] EEA (2016c)

REFERENCES

- ACEA (2015). European Automobile Manufacturers Association. The Automobile Industry Pocket Guide 2015/2016, Brussels, 2015. http://www.acea.be/uploads/publications/POCKET_GUIDE_2015-2016.pdf
- AK Vienna (2015). Lichtblau, G. et al. Passenger car emissions: Standard and real-world fuel consumption. AK Vienna (Vienna Chamber of Labour), Vienna, 2015.
- BMLFUW (2002). Österreichs Programm zur Einhaltung der nationalen Emissionshöchstmengen für bestimmte Luftschadstoffe. Statusbericht 2002 according to Directive 2001/81/EC Art. 8 para. 2.
- BMLFUW (2006). Bericht zum österreichischen Programm zur Einhaltung der nationalen Emissionshöchstmengen für bestimmte Luftschadstoffe according to Directive 2001/81/EC Art. 8 para. 2 and Emissionshöchstmengengesetz-Luft § 6 Abs. 4.
- BMLFUW (2011). Hintergrundpapier NO_x- und NO_2-Emissionen des Straßenverkehrs in Österreich. Annex to Form 3b.
- EC (2016). EC staff working document: Additional analysis to complement the impact assessment supporting the Review of the type-approval framework for motor vehicles Proposal for a Regulation of the European Parliament and the Council on the approval and market surveillance of motor vehicles and their trailers, Brussels 27.1.2016, SWD(2016) 9 final, part 2/2; COM(2016) 31 final, SWD(2016) 10 final. http://eur-lex.europa.eu/resource.html?uri=cellar:903765d1-c5aa-11e5-a4b5-01aa75ed71a1.0001.02/DOC_1&format=PDF
- EEA (2016b). EMEP/CORINAIR Emission Inventory Guidebook – 2007. http://www.eea.europa.eu/publications/EMEPCORINAIR5/page016.html
- EEA (2016c). Explaining road transport emissions. A non-technical guide. EEA, Copenhagen, 2016. ISBN: 978-92-9213-722-9. http://www.eea.europa.eu/publications/explaining-road-transport-emissions.
- Grote, K.-H./Feldhusen, J. (2014): Dubbel: Taschenbuch für den Maschinenbau, 24. Auflage. Springer Verlag, Berlin, Heidelberg, 2014.
- Hausberger, S. et al. (2003). Emission functions for heavy duty vehicles in the handbook emission factors for road traffic. Wien 2003. ISBN: 3-85457-679-X. http://www.umweltbundesamt.at/fileadmin/site/publikationen/BE223.pdf
- Hausberger, S. (2006). Emission Levels of Diesel Cars, EURO1 to EURO 4. Preliminary Results of measurements under NEDC and CADC conditions. Presentation held on 2nd February 2006, Hearing for European vehicle OEMs in Brussels. http://groupware.sinanet.isprambiente.it/expert_panel/library/tfeip-ept_mi23mar07/hausberger_02022006pdf/download/1/Hausberger%20Bruessel_02022006.pdf
- Hausberger, S. (2010). Hintergrundpapier - NO_x und NO_2-Emissionen des Straßenverkehrs in Österreich. https://circabc.europa.eu/webdav/CircaBC/env/ambient/Library/extension_notifications/notifications_extensions/at/notification_30092011/notification_30092011/Annex_to_Form_3B_AT.pdf
- ICCT (2007). Letter to Vice-President of the EC Günter Verheugen. On 3 September 2007. http://ec.europa.eu/DocsRoom/documents/3604/attachments/1/translations/en/renditions/native

- ICCT (2014). Mock, P. et al. The WLTP: How a new test procedure for cars will affect fuel consumption values in the EU. Working Paper 2014-09. ICCT, 2014. http://www.theicct.org/sites/default/files/publications/ICCT_WLTP_EffectEU_20141029.pdf
- ICCT (2015). Mock, P./German, J. The future of vehicles emissions testing and compliance. Berlin: ICCT Europe, 2015. http://www.theicct.org/sites/default/files/publications/ICCT_future-vehicle-testing_20151123.pdf
- KBA (2016). Bericht der Untersuchungskommission „Volkswagen". BMVI - Federal Ministry of Transport and Digital Infrastructure (BMVI), Berlin, 2016. http://www.bmvi.de/SharedDocs/DE/Anlage/VerkehrUndMobilitaet/Strasse/bericht-untersuchungskommission-volkswagen.pdf?__blob=publicationFile

Internet links

- Bosch (2016). Bosch Engineering GmbH – promotion brochure. Technischer Dienst für EU-Fahrzeugzulassungen von Personenkraftwagen: http://www.bosch-engineering.de/media/de/pdfs/dienstleistungen_1/technischer_dienst/Flyer_Technischer_Dienst_De.pdf (2 May 2016)
- EC - DG Growth (2016). European EC tightens rules for safer and cleaner cars. News article published on 27 January 2016: http://ec.europa.eu/growth/tools-databases/newsroom/cf/itemdetail.cfm?item_id=8643&lang=en&tpa_id=0&title=European-EC-tightens-rules-for-safer-and-cleaner-cars (2 May 2016).
- EC (2016a). European EC – Document. Automotive industry - Approval Authorities of the MS. Published on 17 February 2016: http://ec.europa.eu/DocsRoom/documents/15493 (2 May 2016)
- EC (2016b). European EC – Document. Technical Services [...]. Various publication dates: http://ec.europa.eu/DocsRoom/documents?tags=technical-service-auto&pageSize=30&sortCol=title&sortOrder=asc (2 May 2016)
- EC (2015a). European EC - Fact Sheet. FAQ - Air pollutant emissions standards. Press Release, Brussels, 25 September 2015: http://europa.eu/rapid/press-release_MEMO-15-5705_en.htm (15 April 2016).
- EC (2015b). European EC – Press release. EC welcomes MS' agreement on robust testing of air pollution emissions by cars. Press release, Brussels, 28 October 2015: http://europa.eu/rapid/press-release_IP-15-5945_en.htm (15 April 2016).
- EEA (2016). European Environment Agency – Database. Monitoring of CO_2 emissions from passenger cars – Regulation 443/2009. Published on 14 April 2016: http://www.eea.europa.eu/data-and-maps/data/co2-cars-emission-10#tab-european-data (2 May 2016)
- KBA (2009). Wegweiser zur EG-Fahrzeugtypengenehmigung nach der Richtlinie 2007/46/EG: https://www.kba.de/DE/Fahrzeugtechnik/Zum_Herunterladen/ErteilungTypgenehmigungen/Wegweiser_pdf.pdf?__blob=publicationFile&v=4 (15 April 2016).
- Opel (2016). Opel: Zuhause in der ganzen Welt. Produktionsstätten: http://www.opel.de/opel-erleben/ueber-opel/company/produktionsstaetten.html (2 May 2016)

- Reuters (2016). German regulators hunting for defeat device find thermal window: http://www.reuters.com/article/volkswagen-emissions-thermal-idUSL5N17P55D (23 May 2016).
- STA (2016). Swedish Transport Agency (Transport Styrelsen). Information on national programmes for ISC verification: http://www.transportstyrelsen.se/sv/vagtrafik/Miljo/Luftkvaliet-i-tatorter/Avgaser/Hallbarhetsprovning-av-avgasrening/ (2 May 2016)
- UNECE (2013). Development of a world-wide harmonized light duty driving test cycle (WLTC): https://www.unece.org/fileadmin/DAM/trans/doc/2014/wp29grpe/GRPE-68-03e.pdf (15 April 2016).
- VCA (2016a). Vehicle certification from automotive specialists. Type approval brochure: http://www.dft.gov.uk/vca/additional/files/vehicle-type-approval/related-information/type-approval-brochure.pdf (15 April 2016).
- VCA (2016b): European Type Approval for Automotive Systems and Components. VCA004, Revision No 11: http://www.dft.gov.uk/vca/additional/files/vehicle-type-approval/vehicle-type-approval/vca004.pdf (15 April 2016).

Legislation

- 97/836/EC: Council Decision of 27 November 1997 with a view to accession by the European Community to the Agreement of the United Nations Economic EC for Europe concerning the adoption of uniform technical prescriptions for wheeled vehicles, equipment and parts which can be fitted to and/or be used on wheeled vehicles and the conditions for reciprocal recognition of approvals granted on the basis of these prescriptions ('Revised 1958 Agreement'). http://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:31997D0836
- Regulation No 83 of the Economic EC for Europe of the United Nations (UNECE) — Uniform provisions concerning the approval of vehicles with regard to the emission of pollutants according to engine fuel requirements. http://www.unece.org/trans/main/wp29/wp29regs81-100.html
- Directive 2001/95/EC of the European Parliament and of the Council of 3 December 2001 on general product safety. http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1463749495858&uri=CELEX:32001L0095
- Council Directive 70/156/EEC of 6 February 1970 on the approximation of the laws of the Member States relating to the type approval of motor vehicles and their trailers. http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:31970L0156
- Council Directive 70/220/EEC of 20 March 1970 on the approximation of the laws of the Member States relating to measures to be taken against air pollution by gases from positive-ignition engines of motor vehicles. http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX:31970L0220
- Directive 2001/81/EC of 23 October 2001 of the European Parliament and of the Council on national emission ceilings for certain atmospheric pollutants. http://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1463749599420&uri=CELEX:32001L0081
- COM(2016) 31 final (of 27.1.2016). Proposal for a Regulation of the European Parliament and of the Council on the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52016PC0031

ANNEX

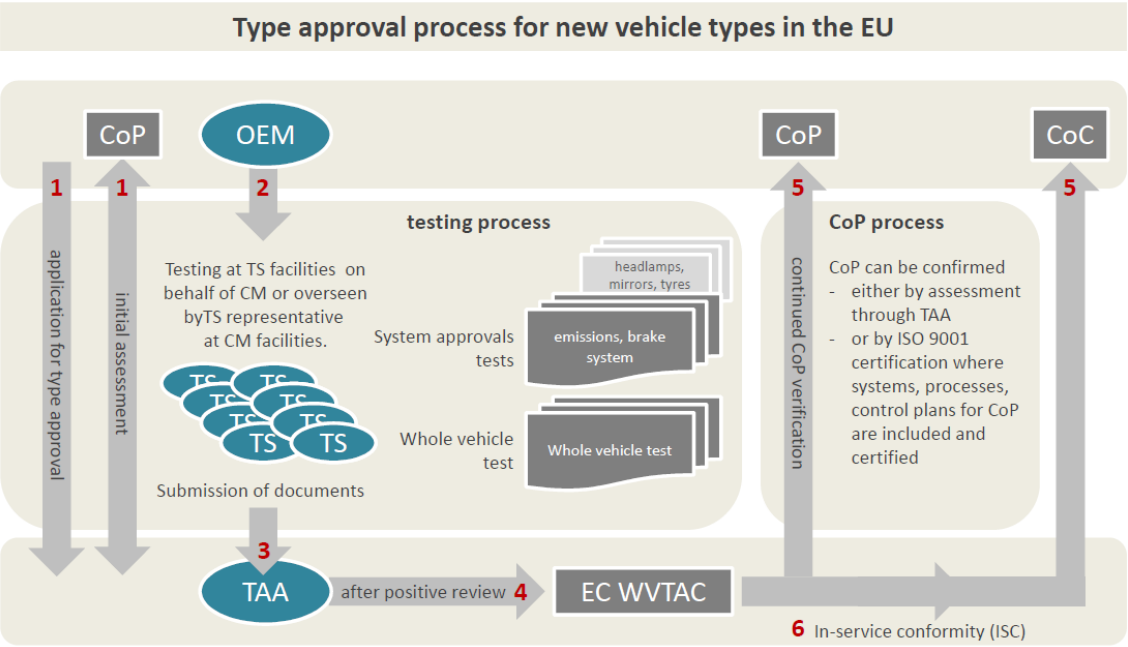
In-depth analysis of the "Legal obligations as regards emission measurements in the EU automotive sector"

Stakeholder questionnaire ENGLISH

Status: 19.04.2016

BLOCK A) Structure of the type approval process

1. Please take a look at the following diagram and let us know, if the type approval process is shown correctly.



abbreviations:

CM...	*car manufacturer*
TS...	*technical service*
TAA...	*type approval authority*
EC WVTAC...	*With the EC whole vehicle type approval certificate based on EC Directives the approval of the whole vehicles (in addition to vehicle systems and separate components) is approved.*
CoP...	*Conformity of production*
CoC...	*Certificate of conformity = prerequisite of vehicle registration in EU MS*
MS...	*Member State*

2. What are the tasks of the stakeholders European Commission (EC), Car Manufacturer (CM), Technical Service (TS), Type Approval Authority (TAA) und Member State (MS) in the whole type approval process, and how are these tasks performed in practice?

3. Are TS and TAA necessarily in the same MS? Do you have examples of TS representing the national TAA at the same time?

4. Is it obligatory for TS willing to take part in the type approval process, to become accredited? If yes, by which standards?

5. Are TAA obliged (or is it voluntarily) to conduct random emission testing of cars of the same model as the one tested in the course of the type approval process, and do you know any TAA carrying out such tests? How is the Conformity of Production ensured?

6. How is in-use-testing performed and which consequences are expected if the test results are not satisfactory?

BLOCK B) Weaknesses of the type approval process

1. Is rather the TS or the TAA predetermining the technical standards within the type approval process and why?

2. What are the possible economical relationships between the stakeholders CM, TS and TAA (shareholdings and subsidiaries, etc.)? How intensive are communication and cooperation between the stakeholders?

3. Which are the most relevant TS on the European market, which TS perform high volumes of testing?

4. Why are those TS performing higher volumes? Are there any competitive advantages? (legal basis of the MS, differences in the quality of testing, lower costs, shareholding, etc.)

5. Why do statistics show high volumes of type approval testing in MS without relevant car manufacturing industry? (e.g.: LUX, NLD)

BLOCK C) Improving the type approval process

1. According to your experience, what are the main weaknesses in the whole type approval process, facilitating developments like the Volkswagen emission scandal?

2. Would you support the setting up of independent TS financed by the EU and centralized TAA on European level?

3. What are the main reasons, why the knowledge about the discrepancies between real-drive- and laboratory-emissions have not been communicated and utilized properly by the EU in the last years?

NOTES

CAT: QA-02-16-572-EN-C (paper)
CAT: QA-02-16-572--EN-N (pdf)

DIRECTORATE-GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT A
ECONOMIC AND SCIENTIFIC POLICY

Role

Policy departments are research units that provide specialised advice to committees, inter-parliamentary delegations and other parliamentary bodies.

Policy Areas

- Economic and Monetary Affairs
- Employment and Social Affairs
- Environment, Public Health and Food Safety
- Industry, Research and Energy
- Internal Market and Consumer Protection

Documents

Visit the European Parliament website:
http://www.europarl.europa.eu/supporting-analyses

PHOTO CREDIT:
iStockphoto.com; Shutterstock/beboy

ISBN 978-92-823-9423-6 (paper)
ISBN 978-92-823-9424-3 (pdf)

doi:10.2861/166395 (paper)
doi:10.2861/180182 (pdf)

Publications Office

Legal obligations relating to emission measurements in the EU automotive sector