Chapter 8
On Board Diagnostic Systems (OBD)

1. INTRODUCTION

This chapter describes the provisions specific to the on board diagnostic (OBD) system for the emission control systems of motor vehicles.

2. DEFINITIONS

For the purposes of this chapter, the following definitions, in addition to the definitions contained in section 2 of chapter I of this part, apply:

'**access**' means the availability of all emission-related OBD data including all fault codes required for the inspection, diagnosis, servicing or repair of emissions related parts of the vehicle, via the serial interface of the standard diagnostic connector.

'**deficiency**' means, in respect of engine OBD systems, that up to two separate components or systems that are monitored contain temporary or permanent operating characteristics that impair the otherwise efficient OBD monitoring of those components or systems or do not meet all the other detailed requirements for OBD. Engines or vehicles in respect of their engine may be type-approved, registered and sold with such deficiencies according to the requirements of section 4.3 of this chapter.

'**deteriorated component / system**' means an engine or exhaust after treatment component/system that has been intentionally deteriorated in a controlled manner by the manufacturer for the purpose of conducting a type-approval test on the OBD system.

'**OBD test cycle**' means a driving cycle, which is a version of the ESC test cycle having the same running-order of the 13 individual modes as described in section 2.7.1 of appendix 1 to chapter III of this part but where the length of each mode is reduced to 60 seconds.

'**operating sequence**' means the sequence used for determining the conditions for extinguishing the MI. It consists of an engine start-up, an operating period, an engine shut-off, and the time until the next start-up, where the OBD monitoring is running and a malfunction would be detected if present.

'**pre conditioning cycle**' means the running of at least three consecutive OBD test cycles or emission test cycles for the purpose of achieving stability of the engine operation, the emission control system and OBD monitoring readiness.

'**repair information**' means all information required for diagnosis, servicing, inspection, periodic monitoring or repair of the engine and which the manufacturers provide for their authorised dealers/repair shops. Where necessary, such information shall include service handbooks, technical manuals, diagnosis information (e.g. minimum and maximum theoretical values for measurements), wiring diagrams, the software calibration identification number applicable to an engine type, information enabling the update of the software of the electronic systems in accordance with the specifications of the vehicle manufacturer, instructions for individual and special cases, information provided concerning tools and equipment, data record information and two-directional monitoring and test data. The manufacturer shall not be obliged to make available that information which is covered by intellectual property rights or constitutes specific know-how of manufacturers and/or OEM suppliers; in this case the necessary technical information shall not be improperly withheld.

'**standardised**' means that all emission related OBD data (i.e. stream information in the case a scanning tool is used), including all fault codes used, shall be produced only in accordance with industry standards which, by virtue of the fact that their format and the permitted options are clearly defined, provide for a maximum level of harmonisation in the motor vehicle industry, and whose use is expressly permitted in this part.

'**unrestricted**' means:

— access not dependent on an access code obtainable only from the manufacturer, or a similar device,

or

— access allowing evaluation of the data produced without the need for any unique decoding information, unless that information itself is standardised.

'**warm-up cycle**' means sufficient engine operation such that the coolant temperature has risen by at least 22° K from engine starting and reaches a minimum temperature of 343° K (70 °C).

3. REQUIREMENTS AND TESTS

3.1 General requirements

3.1.1 OBD systems must be designed, constructed and installed in a vehicle so as to enable it to identify types of malfunction over the entire life of the engine. In achieving this objective the approval authority must accept that engines which have been used in excess of the appropriate durability period defined in section 3.2.1.8 of chapter VII of this part may show some deterioration in OBD system

performance such that the OBD thresholds given in section 7 of this chapter may be exceeded before the OBD system signals a failure to the driver of the vehicle.

3.1.2 A sequence of diagnostic checks must be initiated at each engine start and completed at least once provided that the correct test conditions are met. The test conditions must be selected in such a way that they all occur under the driving conditions as represented by the test defined in section 2 of appendix 1 to this chapter.

3.1.2.1 Manufacturers are not required to activate a component / system exclusively for the purpose of OBD functional monitoring under vehicle operating conditions when it would not normally be active (e.g. activation of a reagent tank heater of a deNOx system or combined deNOx-particulate filter when such a system would not normally be active).

3.1.3 OBD may involve devices, which measure, senses or responds to operating variables (e.g. vehicle speed, engine speed, gear used, temperature, intake pressure or any other parameter) for the purpose of detecting malfunctions and of minimising the risk of indicating false malfunction. These devices are not defeat devices.

3.1.4 Access to the OBD system required for the inspection, diagnosis, servicing or repair of the engine must be unrestricted and standardised. All emission related fault codes must be consistent with those described in section 6.8.5 of this chapter.

3.2 OBD requirements

3.2.1 From 1st April 2013 the OBD system of all diesel engines and of vehicles equipped with a diesel engine must indicate the failure of an emission-related component or system of the engine system when that failure results in an increase in emissions above the OBD thresholds given in section 7 of this chapter.

3.2.2 In satisfying the requirements, the OBD system must monitor for:

3.2.2.1 Complete removal of a catalyst, where fitted in a separate housing, that may or may not be part of a deNO_X system or particulate filter.

3.2.2.2 reduction in the efficiency of the deNO_X system, where fitted, with respect to the emissions of NO_X only.

3.2.2.3 reduction in the efficiency of the particulate filter, where fitted, with respect to the emissions of particulate only.

3.2.2.4 reduction in the efficiency of a combined deNO_X-particulate filter system, where fitted, with respect to both the emissions of NO_X and particulate.

3.2.3 Major Functional Failure

3.2.3.1 As an alternative to monitoring against the OBD threshold limits with respect to sections 3.2.2.1 to 3.2.2.4 of this chapter, OBD systems of diesel engines may monitor for major functional failure of the following components:

- a catalyst, where fitted as a separate unit, that may or may not be part of a deNO_X system or particulate filter

— a deNO_X system, where fitted

- a particulate filter, where fitted

— a combined deNO_X-particulate filter system.

3.2.3.2. In the case of an engine equipped with a deNO_X system, examples of monitoring for major functional failure are for complete removal of the system or replacement of the system by a bogus system (both intentional major functional failure), lack of required reagent for a deNO_X system, failure of any SCR electrical component, any electrical failure of a component (e.g. sensors and actuators, dosing control unit) of a deNO_X system including, when applicable, the reagent heating system, failure of the reagent dosing system (e.g. missing air supply, clogged nozzle, dosing pump failure).

3.2.3.3 In the case of an engine equipped with a particulate filter, examples of monitoring for major functional failure are for major melting of the trap substrate or a clogged trap resulting in a differential pressure out of the range declared by the manufacturer, any electrical failure of a component (e.g. sensors and actuators, dosing control unit) of a particulate filter, any failure, when applicable, of a reagent dosing system (e.g. clogged nozzle, dosing pump failure).

3.2.4 Manufacturers may demonstrate to the approval authority that certain components or systems need not be monitored if, in the event of their total failure or removal, emissions do not exceed the thresholds limits for OBD given in section 7 of this chapter when measured over the cycles shown in section 1.1 of Appendix 1 to this Chapter. This provision shall not apply to an exhaust gas recirculation (EGR) device, a deNO_X system, a particulate filter or a combined deNOx-particulate filter system nor shall it apply to a component or system that is monitored for major functional failure.

3.3 In satisfying the above requirements, the OBD system must also monitor for:

3.3.1 The fuel-injection system electronic, fuel quantity and timing actuator(s) for circuit continuity (i.e. open circuit or short circuit) and total functional failure.

3.3.2 All other engine or exhaust after treatment emission-related components or systems, which are connected to a computer, the failure of which would result in tailpipe emissions exceeding the OBD threshold limits given in section 7 of this chapter. At a minimum, examples include the exhaust gas recirculation (EGR) system, systems or components for monitoring and control of air mass-flow, air volumetric flow (and temperature), boost pressure and inlet manifold pressure (and relevant sensors to enable these functions to be carried out), sensors and actuators of a deNO_X system, sensors and actuators of an electronically activated active particulate filter.

3.3.3 Any other emission-related engine or exhaust after treatment component or system connected to an electronic control unit must be monitored for electrical disconnection unless otherwise monitored.

3.3.4 In the case of engines equipped with an after treatment system using a consumable reagent, the OBD system must monitor for:

— lack of any required reagent

— the quality of the required reagent being within the specifications declared by the manufacturer in chapter II to this Part.

— reagent consumption and dosing activity

according to section 6.5.4 of chapter I to this part.

3.4 OBD operation and temporary disablement of certain OBD monitoring capabilities

3.4.1. The OBD system must be so designed, constructed and installed in a vehicle as to enable it to comply with the requirements of this chapter during the conditions of use defined in section 6.1.5.4 of chapter I of this part.

Outside these normal operating conditions the emission control system may show some degradation in OBD system performance such that the thresholds given in section 7 of this chapter may be exceeded before the OBD system signals a failure to the driver of the vehicle.

The OBD system must not be disabled unless one or more of the following conditions for disablement are met:

3.4.1.1 The affected OBD monitoring systems may be disabled if its ability to monitor is affected by low fuel levels. For this reason, disablement is permitted when the fuel tank level falls below 20 % of the nominal capacity of the fuel tank.
3.4.1.2 The affected OBD monitoring systems may be temporarily disabled during the operation of an auxiliary emission control strategy as described in section 6.1.5.1 of Chapter I to this Part.

3.4.1.3 The affected OBD monitoring systems may be temporarily disabled when operational safety or limp-home strategies are activated.

3.4.1.4 For vehicles designed to accommodate the installation of power take-off units, disablement of affected OBD monitoring systems is permitted provided disablement takes place only when the power take-off unit is active and the vehicle is not being driven.

3.4.1.5 The affected OBD monitoring systems may be disabled temporarily during the periodic regeneration of an emission control system downstream of the engine (i.e. a particulate filter, deNO_X system or combined deNO_X-particulate filter).

3.4.1.6 The affected OBD monitoring systems may be disabled temporarily outside the conditions of use defined in section 6.1.5.4 of chapter I of this part when this disablement can be justified by a limitation of the OBD monitoring (including modelling) capability.

3.4.2 The OBD monitoring system is not required to evaluate components during malfunction if such evaluation would result in a risk to safety or component failure.

3.5 Activation of malfunction indicator (MI)

3.5.1 The OBD system must incorporate a malfunction indicator readily visible to the vehicle operator. Except in the case of section 3.5.2 of this chapter, the MI (e.g. symbol or lamp) must not be used for any purpose other than emission related malfunction except to indicate emergency start-up or limp-home routines to the driver. Safety related messages can be given the highest priority. The MI must be visible in all reasonable lighting conditions. When activated, it must display a symbol in conformity with ISO 2575 [(1)] (as a dashboard telltale lamp or a symbol on a dashboard display).A vehicle must not be equipped with more than one general purpose MI for emission-related problems. Displaying separate specific information is permitted (e.g. such as information dealing with brake system, fasten seat belt, oil pressure, servicing requirements, or indicating the lack of necessary reagent for the deNOx system). The use of red for the MI is prohibited.

(1) Symbol numbers F01 or F22.

3.5.2 The MI may be used to indicate to the driver that an urgent service task needs to be carried out. Such an indication may also be accompanied by an appropriate message on a dashboard display that an urgent servicing requirement needs to be carried out.

3.5.3 For strategies requiring more than a preconditioning cycle for MI activation, the manufacturer must provide data and/or an engineering evaluation which adequately demonstrates that the monitoring system is equally effective and timely in detecting component deterioration. Strategies requiring on average more than ten OBD or emission test cycles for MI activation are not accepted.

3.5.4 The MI must also activate whenever the engine control enters a emission default mode of operation. The MI must also activate if the OBD system is unable to fulfill the basic monitoring requirements specified in this Document.

3.5.5 Where reference is made to this section, the MI must be activated and, in addition, a distinct warning mode should also be activated, e.g. flashing MI or activation of a symbol in conformity with ISO 2575 (1) in addition to MI activation.

(1) Symbol number F24.

3.5.6 The MI must activate when the vehicle's ignition is in the 'key-on' position before engine starting or cranking and de-activate within 10 seconds after engine starting if no malfunction has previously been detected.

3.6 Fault code storage

The OBD system must record fault code(s) indicating the status of the emission-control system. A fault code must be stored for any detected and verified malfunction causing MI activation and must identify the malfunctioning system or component as uniquely as possible. A separate code should be stored indicating the expected MI activation status (e.g. MI commanded 'ON', MI commanded 'OFF').

Separate status codes must be used to identify correctly functioning emission control systems and those emission control systems that need further engine operation to be fully evaluated. If the MI is activated due to malfunction or emission default modes of operation, a fault code must be stored that identifies the likely area of malfunction. A fault code must also be stored in the cases referred to in sections 3.3.1 and 3.3.3 of this chapter.

3.6.1 If monitoring has been disabled for 10 driving cycles due to the continued operation of the vehicle under conditions conforming to those specified in section

3.4.1.2 of this Annex, readiness for the subject monitoring system may be set to 'ready' status without monitoring having been completed.

3.6.2 The hours run by the engine while the MI is activated must be available upon request at any instant through the serial port on the standard link connector, according to the specifications given in section 6.8 of this Chapter.

3.7 Extinguishing the MI

3.7.1 The MI may be de-activated after three subsequent sequential operating sequences or 24 engine running hours during which the monitoring system responsible for activating the MI ceases to detect the malfunction and if no other malfunction has been identified that would independently activate the MI.

3.7.2 In the case of MI activation due to lack of reagent for the deNO_X system, or combined deNO_X particulate after-treatment device or use of a reagent outside the specifications declared by the manufacturer, the MI may be switched back to the previous state of activation after filling or replacement of the storage medium with a reagent having the correct specifications.

3.7.3 In the case of MI activation due to incorrect operation of the engine system with respect to NO_X control measures, or incorrect reagent consumption and dosing activity, the MI may be switched back to the previous state of activation if the conditions given in section 6.5.3, 6.5.4 and 6.5.7 of chapter I to this part no longer apply.

3.8 Erasing a fault code

3.8.1 The OBD system may erase a fault code and the hours run by the engine and freeze-frame information if the same fault is not re-registered in at least 40 engine warm-up cycles or 100 engine running hours, whichever occurs first, with the exception of the cases referred to in section 3.8.2 of this chapter.

3.8.2 In the case of a non erasable fault code being generated according to sections 6.5.3 or 6.5.4 of chapter I of this part, the OBD system shall retain a record of the fault code and the hours run by the engine during MI activation for at least 400 days or 9600 hours of engine operation.

Any such fault code and the corresponding hours run by the engine during MI activation shall not be erased through use of any external diagnostic or other tool as referred to in section 6.8.3 of this chapter

4. REQUIREMENTS RELATING TO THE TYPE-APPROVAL OF OBD SYSTEMS

4.1 For the purpose of type-approval, the OBD system shall be tested according to the procedures given in appendix 1 to this chapter.

An engine representative of its engine family (see section 8 of chapter I to this part) shall be used for the OBD demonstration tests or the test report of the parent OBD system of the OBD engine family will be provided to the type-approval authority as an alternative to carrying out the OBD demonstration test.

4.1.1 In the case of OBD referred to in section 3.2 of this chapter, the OBD system must:

4.1.1.1 Indicate the failure of an emission-related component or system when that failure results in an increase in emissions above the OBD thresholds given in section 7 of this chapter, or

4.1.1.2 Where appropriate, indicate any major functional failure of an exhaust after treatment system.

4.1.1.3 Indicate the lack of any required reagent necessary for the operation of an exhaust after treatment system.

4.2 Installation requirements

4.2.1 The installation on the vehicle of an engine equipped with an OBD system shall comply with the following provisions of this chapter with respect to the vehicle equipment:

— the provisions of sections 3.5.1, 3.5.2 and 3.5.5 of this chapter concerning the MI and, where appropriate, additional warning modes

— when applicable, the provisions of section 6.8.3.1 of this chapter concerning the use of an on-board diagnostic facility

— the provisions of section 6.8.6 of this chapter concerning the connection interface.

4.3 Type-approval of an OBD system containing deficiencies

4.3.1 A manufacturer may request to the authority that an OBD system be accepted for type-approval even though the system contains one or more deficiencies such that the specific requirements of this chapter are not fully met.

4.3.2 In considering the request, the authority shall determine whether compliance with the requirements of this chapter is feasible or unreasonable.

The authority shall take into consideration data from the manufacturer that details such factors as, but not limited to, technical feasibility, lead time and production cycles including phase-in or phase-out of engines designs and programmed upgrades of computers, the extend to which the resultant OBD system will be effective in complying with the requirements of this directive and that the manufacturer has demonstrated an acceptable level of effort toward the requirements of this part.

4.3.3 The authority will not accept any deficiency request that includes the complete lack of a required diagnostic monitor.

4.3.4 The authority shall not accept any deficiency request that does not respect the OBD threshold limits given in section 7 of this chapter.

4.3.5 In determining the identified order of deficiencies, deficiencies relating to OBD in respect of sections 3.2.2.1, 3.2.2.2, 3.2.2.3, 3.2.2.4 and 3.3.1 of this chapter shall be identified first.

4.3.6 Prior to or at the time of type-approval, no deficiency shall be granted in respect of the requirements of section 3.2.3 and section 6, except subsection 6.8.5 of this chapter.

4.3.7 Deficiency period

4.3.7.1 A deficiency may be carried-over for a period of two years after the date of type-approval of the engine type or vehicle in respect of its engine type, unless it can be adequately demonstrated that substantial engine modifications and additional lead-time beyond two years would be necessary to correct the deficiency. In such a case, the deficiency may be carried-out for a period not exceeding three years.

4.3.7.2 A manufacturer may request that the original type-approval authority grant a deficiency retrospectively when such a deficiency is discovered after the original type-approval. In this case, the deficiency may be carried-over for a period of two years after the date of notification to the type approval authority unless it can be adequately demonstrated that substantial engine modifications and additional lead-time beyond two years would be necessary to correct the deficiency. In such a case, the deficiency may be carried-out for a period not exceeding three years.

5. ACCESS TO OBD INFORMATION

5.1 Replacement parts, diagnostic tools and test equipment

5.1.1 Applications for type-approval or amendment of a type-approval according to this part shall be accompanied by the relevant information concerning the OBD system. This relevant information shall enable manufacturers of replacement or retrofit components to make the parts they manufacture compatible with the OBD system with a view to fault-free operation assuring the vehicle user against malfunctions. Similarly, such relevant information shall enable the manufacturers of diagnostic tools and test equipment to make tools and equipment that provide for effective and accurate diagnosis of emission control systems.

5.1.2 Upon request, the type-approval authorities shall make changes in the type approval certificate containing the relevant information on the OBD system available to any interested components, diagnostic tools or test equipment manufacturer on a non-discriminatory basis.

5.1.2.1 In the case of replacement or service components, information can only be requested for such components that are subject to type approval, or for components that form part of a system that is subject to type approval.

5.1.2.2 The request for information must identify the exact specification of the engine model type/engine model type within an engine family for which the information is required. It must confirm that the information is required for the development of replacement or retrofit parts or components or diagnostic tools or test equipment.

5.2 Repair information

5.2.1. No later than three months after the manufacturer has provided any authorised dealer or repair shop with repair information, the manufacturer shall make that information (including all subsequent amendments and supplements) available upon reasonable and non-discriminatory payment.

5.2.2. The manufacturer must also make accessible, where appropriate upon payment the technical information required for the repair or maintenance of motor vehicles unless that information is covered by an intellectual property right or constitutes essential, secret know-how which is identified in an appropriate form; in such case, the necessary technical information must not be withheld improperly.

Entitled to such information is any person engaged in commercially servicing or repairing, road-side rescuing, inspecting or testing of vehicles or in manufacturing or selling replacement or retro-fit components, diagnostic tools and test equipment.

5.2.3. In the event of failure to comply with these provisions the approval authority shall take appropriate measures to ensure that repair information is

available, in accordance with the procedures laid down for type-approval and in-service surveys.

6. DIAGNOSTIC SIGNALS

6.1 Upon determination of the first malfunction of any component or system, 'freeze-frame' engine conditions present at the time must be stored in computer memory. Stored engine conditions must include, but are not limited to calculated load value, engine speed, coolant temperature, intake manifold pressure (if available), and the fault code which caused the data to be stored. For freeze-frame storage, the manufacturer must choose the most appropriate set of conditions facilitating effective repairs.

6.2 Only one frame of data is required. Manufacturers may choose to store additional frames provided that at least the required frame can be read by a generic scan tool meeting the specifications of sections 6.8.3 and 6.8.4 of this chapter. If the fault code causing the conditions to be stored is erased in accordance with section 3.8 of this chapter, the stored engine conditions may also be erased.

6.3 If available, the following signals in addition to the required freeze-frame information must be made available on demand through the serial port on the standardised data link connector, if the information is available to the on-board computer or can be determined using information available to the on-board computer: diagnostic trouble codes, engine coolant temperature, injection timing, intake air temperature, manifold air pressure, air flow rate, engine speed, pedal position sensor output value, calculated load value, vehicle speed and fuel pressure.

The signals must be provided in standard units based on the specifications given in section 6.8. Actual signals must be clearly identified separately from default value or limp-home signals.

6.4 For all emission control systems for which specific on-board evaluation tests are conducted, separate status codes, or readiness codes, must be stored in computer memory to identify correctly functioning emission control systems and those emission control systems which require further vehicle operation to complete a proper diagnostic evaluation. A readiness code need not be stored for those monitors that can be considered continuously operating monitors. Readiness codes should never be set to 'not ready' status upon 'key-on' or 'key-off'. The intentional setting of readiness codes to 'not ready' status via service procedures must apply to all such codes, rather than applying to individual codes.

6.5 The OBD requirements and the major emission control systems monitored by the OBD system consistent with section 6.8.4 must be available through the

serial data port on the standardised data link connector according to the specifications given in section 6.8.

6.6 The software calibration identification number as declared in chapters II and VI of this part shall be made available through the serial port of the standardised diagnostic connector. The software calibration identification number shall be provided in a standardised format.

6.7 The vehicle identification number (VIN) number shall be made available through the serial port of the standardised diagnostic connector. The VIN number shall be provided in a standardised format.

6.8 The emission control diagnostic system must provide for standardised or unrestricted access and conform to either ISO 15765 or SAE J1939, as specified in the following sections [(1)]:

[(1)] The use of the future ISO single protocol standard developed in the framework of the UN/ECE for a world-wide global technical regulation on heavy-duty OBD will be considered by the Commission in a proposal to replace the use of the SAE J1939 and ISO 15765 series of standards to satisfy the appropriate requirements of section 6 as soon as the ISO single protocol standard has reached the DIS stage.

6.8.1 The use of either ISO 15765 or SAE J1939 shall be consistent throughout sections 6.8.2 to 6.8.5.

6.8.2 The on-board to off-board communications link must conform to ISO 15765-4 or to the similar clauses within the SAE J1939 series of standards.

6.8.3 Test equipment and diagnostic tools needed to communicate with OBD systems must meet or exceed the functional specification given in ISO 15031-4 or SAE J1939-73 section 5.2.2.1.

6.8.3.1 The use of an on-board diagnostic facility such as a dashboard mounted video display device for enabling access to OBD information is permitted but this is in addition to enabling access to OBD information by means of the standard diagnostic connector.

6.8.4 Diagnostic data, (as specified in this section) and bi-directional control information must be provided using the format and units described in ISO 15031-5 or SAE J1939-73 section 5.2.2.1 and must be available using a diagnostic tool meeting the requirements of ISO 15031-4 or SAE J1939-73 section 5.2.2.1.

The manufacturer shall provide a national standardisation body with emission-related diagnostic data, e.g. PID's, OBD monitor Id's, Test Id's not specified in ISO 15031-5 but related to this part.

6.8.5 When a fault is registered, the manufacturer must identify the fault using the most appropriate fault code consistent with those given in Section 6.3 of ISO 15031-6 relating to emission-related system diagnostic trouble codes. If such identification is not possible, the manufacturer may use diagnostic trouble codes according to Sections 5.3 and 5.6 of ISO 15031-6. The fault codes must be fully accessible by standardised diagnostic equipment complying with the provisions of section 6.8.3 of this Chapter.

The manufacturer shall provide a national standardisation body with emission-related diagnostic data, e.g. PID's, OBD monitor Id's, Test Id's not specified in ISO 15031-5 but related to this part.

As an alternative, the manufacturer may identify the fault using the most appropriate fault code consistent with those given in SAE J2012 or in SAE J1939-73.

6.8.6 The connection interface between the vehicle and the diagnostic tester

must be standardised and must meet all the requirements of ISO 15031-3 or

SAE J1939-13.

In the case of category N2, N3, M2, and M3 vehicles, as an alternative to the connector location described in the above standards and provided all other requirements of ISO 15031-3 are met, the connector may be located in a suitable position by the side of the driver's seat, including on the floor of the cabin. In this case the connector should be accessible by a person standing outside the vehicle and not restrict access to the driver's seat.

The installation position must be subject to agreement of the approval authority such that it is readily accessible by service personnel but protected from accidental damage during normal conditions of use.

7. THRESHOLD LIMITS FOR OBD

The OBD threshold limits shall be as follows:
Mass of Oxides of Nitrogen (NO_X) = 7.0 g/kWh
Mass of Particulate (PT) = 0.10 g/kWh

Appendix 1

ON-BOARD DIAGNOSTIC (OBD) SYSTEM APPROVAL TESTS

1. INTRODUCTION

This Appendix describes the procedure for checking the function of the on board diagnostic (OBD) system installed on the engine by failure simulation of relevant emission-related systems in the engine management or emission control system. It also sets procedures for determining the durability of OBD systems.

1.1 Deteriorated components / systems

In order to demonstrate the efficient monitoring of an emission control system or component, the failure of which may result in tailpipe emissions exceeding the OBD threshold limits, the manufacturer must make available the deteriorated components and/or electrical devices which would be used to simulate failures.

Such deteriorated components or devices must not cause emissions to exceed the OBD threshold limits given in section 7 of this chapter by more than 20 %.

In the case of type-approval of an OBD system according to this part, the emissions shall be measured over the ESC test cycle (see Appendix 1 to chapter III to this Part)

1.1.1 If it is determined that the installation of a deteriorated component or device on an engine means that a comparison with the OBD threshold limits is not possible (e.g. because the statistical conditions for validating the ETC test cycle are not met), the failure of that component or device may be considered as qualified upon the agreement of the type-approval authority based on technical argumentation provided by the manufacturer.

1.1.2 In the case that the installation of a deteriorated component or device on an engine means that the full load curve (as determined with a correctly operating engine) cannot (even partially) be attained during the test, the deteriorated component or device is considered as qualified upon the agreement of the type-approval authority based on technical argumentation provided by the manufacturer.

1.1.3 The use of deteriorated components or devices that cause engine emissions to exceed the OBD threshold limits given in section 7 of this chapter by no more than 20 % may not be required in some very specific cases (for example, if a limp home strategy is activated, if the engine cannot run any test, or in case of EGR sticking valves, etc). This exception shall be documented by the manufacturer. It is subject to the agreement of the test agency.

1.2 Test principle

When the engine is tested with the deteriorated component or device fitted, the OBD system is approved if the MI is activated. The OBD system is also approved if the MI is activated below the OBD threshold limits.

The use of deteriorated components or devices that cause the engine emissions to exceed the OBD threshold limits given in section 7 of this chapter by no more than 20 % are not required in the specific case of the failure modes described in sections 6.3.1.6 and 6.3.1.7 of this Appendix and also with respect to monitoring for major functional failure.

1.2.1 The use of deteriorated components or devices that cause engine emissions to exceed the OBD threshold limits given in section 7 of this chapter by no more than 20 % may not be required in some very specific cases (for example, if a limp home strategy is activated, if the engine cannot run any test, or in case of EGR sticking valves, etc). This exception shall be documented by the manufacturer. It is subject to the agreement of the test agency.

2. DESCRIPTION OF TEST

2.1 The testing of OBD systems consists of the following phases:

— simulating the malfunction of a component of the engine management or emission control system as described in section 1.1 of this appendix

— preconditioning of the OBD system with a simulated malfunction over the preconditioning cycle specified in section 6.2 of this appendix.

— operating the engine with a simulated malfunction over the OBD test cycle referred to in section 6.1 of this appendix.

— determining whether the OBD system reacts to the simulated malfunction and indicates malfunction in an appropriate manner.

2.1.1 Should the performance (e.g. power curve) of the engine be affected by the malfunction, the OBD test-cycle remains the shortened version of the ESC test-cycle used for the assessing the exhaust emissions of the engine without that malfunction.

2.2 Alternatively, at the request of the manufacturer, malfunction of one or more components may be electronically simulated according to the requirements of section 6 of this appendix.

2.3 Manufacturers may request that monitoring take place outside the OBD test cycle referred to in section 6.1 of this appendix, if it can be demonstrated to the authority that monitoring during conditions encountered during this OBD test cycle would impose restrictive monitoring conditions when the vehicle is used in service.

3. TEST ENGINE AND FUEL

3.1 Engine

The test engine shall comply with the specifications laid down in chapter II of this part.

3.2. Fuel

The appropriate reference fuel as described in chapter IV of this part must be used for testing.

4. TEST CONDITIONS

The test conditions must satisfy the requirements of the emission test described in this part.

5. TEST EQUIPMENT

The engine dynamometer must meet the requirements of chapter III of this part.

6. OBD TEST CYCLE

6.1 The OBD test cycle is a single shortened ESC test cycle. The individual modes shall be performed in the same order as the ESC test cycle, as defined in section 2.7.1 of appendix 1 to chapter III of this part.

The engine must be operated for a maximum of 60 seconds in each mode, completing engine speed and load changes in the first 20 seconds. The specified speed shall be held to within ± 50 rpm and the specified torque shall be held to within ± 2 % of the maximum torque at each speed.

Exhaust emissions are not required to be measured during the OBD test cycle.

6.2 Preconditioning cycle

6.2.1 After introduction of one of the failure modes given in section 6.3 of this appendix, the engine and its OBD system shall be preconditioned by performing a preconditioning cycle.

6.2.2. At the request of the manufacturer and with the agreement of the type-approval authority, an alternative number of a maximum of nine consecutive OBD test cycles may be used.

6.3 OBD system test

6.3.1 Diesel engines and vehicles equipped with a diesel engine

6.3.1.1 After preconditioning according to section 6.2 of this appendix, the test engine is operated over the OBD test cycle described in section 6.1 of this appendix. The MI must activate before the end of this test under any of the conditions given in 6.3.1.2 to 6.3.1.7 of this appendix. The technical service may substitute those conditions by others in accordance with section 6.3.1.7 of this appendix. For the purposes of type-approval, the total number of failures subject to testing, in the case of different systems or components, must not exceed four.

If the test is being carried out to type-approve an OBD-engine family consisting of engines that do not belong to the same engine family, the type approval authority will increase the number of failures subject to testing up to a maximum of four times the number of engine families present in the OBD-engine family. The type-approval authority may decide to curtail the test at any time before this maximum number of failure tests has been reached.

6.3.1.2 Where fitted in a separate housing that may or may not be part of a deNO_X system or diesel particulate filter, replacement of any catalyst with a deteriorated or defective catalyst or electronic simulation of such a failure.

6.3.1.3 Where fitted, replacement of a deNO_X system (including any sensors that are an integral part of the system) with a deteriorated or defective deNO_X system or electronic simulation of a deteriorated or defective deNOx system that results in emissions exceeding the OBD NO_X threshold limit given in section 7 of this chapter.

In the case that the engine is being type-approved according to this part in relation to monitoring for major functional failure, the test of the deNO_X system shall determine that the MI illuminates under any of the following conditions:

— complete removal of the system or replacement of the system by a bogus system

— lack of any required reagent for a deNO_X system

— any electrical failure of a component (e.g. sensors and actuators, dosing control unit) of a deNO_X system, including, when applicable, the reagent heating system

— failure of a reagent dosing system (e.g. missing air supply, clogged nozzle, dosing pump failure) of a deNO$_x$ system

— major breakdown of the system.

6.3.1.4 Where fitted, total removal of the particulate filter or replacement of the particulate filter with a defective particulate filter that results in emissions exceeding the OBD particulate threshold limit given in section 7 of this chapter.

In the case that the engine is being type-approved according to this part in relation to monitoring for major functional failure, the test of the particulate filter shall determine that the MI illuminates under any of the following conditions:

— complete removal of the particulate filter or replacement of the system by a bogus system

— major melting of the particulate filter substrate

— major cracking of the particulate filter substrate

— any electrical failure of a component (e.g. sensors and actuators, dosing control unit) of a particulate filter

— failure, when applicable, of the reagent dosing system (e.g. clogged nozzle, dosing pump failure) of a particulate filter

— a clogged particulate filter resulting in a differential pressure out of the range declared by the manufacturer.

6.3.1.5 Where fitted, replacement of a combined deNOx-particulate filter system (including any sensors that are an integral part of the device) with a deteriorated or defective system or electronic simulation of a deteriorated or defective system that results in emissions exceeding the OBD NOx and particulate threshold limits given in section 7 of this chapter.

In the case that the engine is being type-approved according to this part in relation to monitoring for major functional failure, the test of the combined deNOx-particulate filter system shall determine that the MI illuminates under any of the following conditions:

— complete removal of the system or replacement of the system by a bogus system

— lack of any required reagent for a combined deNO$_X$-particulate filter system

— any electrical failure of a component (e.g. sensors and actuators, dosing control unit) of a combined deNO_X-particulate filter system, including, when applicable, the reagent heating system

— failure of a reagent dosing system (e.g. missing air supply, clogged nozzle, dosing pump failure) of a combined deNO_X-particulate filter system

— major breakdown of a NO_X trap system

— major melting of the particulate filter substrate

— major cracking of the particulate filter substrate

— a clogged particulate filter resulting in a differential pressure out of the range declared by the manufacturer.

6.3.1.6 Disconnection of any fuelling system electronic fuel quantity and timing actuator that results in emissions exceeding any of the OBD thresholds given in section 7 of this chapter.

6.3.1.7 Disconnection of any other emission-related engine component connected to a computer that results in emissions exceeding any of the thresholds given in section 7 of this chapter.

6.3.1.8 In demonstrating compliance with the requirements of 6.3.1.6 and 6.3.1.7 of this appendix and with the agreement of the approval authority, the manufacturer may take appropriate steps to demonstrate that the OBD system will indicate a fault when disconnection occurs.