ANNEX IV

ON-BOARD DIAGNOSTIC SYSTEMS (OBD)

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 Article 3 of this Directive may show some deterioration in OBD system performance such that the OBD thresholds given in the table in Article 4(3) of this Directive 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 Annex.

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 deNO_x system or combined deNO_x-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 Annex.

3.2. OBD Stage 1 requirements

3.2.1. From the dates given in Article 4(1) of this Directive, 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 when that failure results in an increase in emissions above the appropriate OBD thresholds given in the table in Article 4(3) of this Directive.

3.2.2. In satisfying the Stage 1 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 appropriate OBD threshold limits with respect to sections 3.2.2.1 to 3.2.2.4, OBD systems of diesel engines may in accordance with Article 4(1) of this Directive 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 applicable thresholds limits for OBD Stage 1 given in the table in Article 4(3) of this Directive when measured over the cycles shown in section 1.1 of Appendix 1 to this Annex. This provision shall not apply to an exhaust gas recirculation (EGR) device, a $deNO_x$ system, a particulate filter or a combined $deNO_x$-particulate filter system nor shall it apply to a component or system that is monitored for major functional failure.

3.3. OBD Stage 2 requirements

3.3.1. From the dates given in Article 4(2) of this Directive the OBD system of all diesel or gas engines and of vehicles equipped with a diesel or a gas 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 appropriate OBD thresholds given in the table in Article 4(3) of this Directive.

The OBD system must consider the communication interface (hardware and messages) between the engine system electronic control unit(s) (EECU) and any other power train or vehicle control unit when the exchanged information has an influence on the correct functioning of the emission control. The OBD system must diagnose the integrity of the connection between the EECU and the medium that provides the link with these other vehicle components (e.g. the communication bus).

3.3.2. In satisfying the Stage 2 requirements, the OBD system must monitor for:

3.3.2.1 reduction in the efficiency of the catalyst, where fitted in a separate housing, that may or may not be part of a $deNO_x$ system or particulate filter.

3.3.2.2 reduction in the efficiency of the $deNO_x$ system, where fitted, with respect to the emissions of NO_x only.

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

3.3.2.4 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.

3.3.2.5 the interface between the engine electronic control unit (EECU) and any other powertrain or vehicle electrical or electronic system (e.g. the transmission control unit (TECU)) for electrical disconnection.

3.3.3 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 applicable thresholds limits for OBD Stage 2 given in the table in Article 4(3) of this Directive when measured over the cycles shown in section 1.1 of Appendix 1 to this Annex. This provision shall not apply to an exhaust gas recirculation (EGR) device, a $deNO_x$ system, a particulate filter or a combined $deNO_x$-particulate filter system.

3.4. Stage 1 and Stage 2 requirements

3.4.1. In satisfying both the Stage 1 or Stage 2 requirements the OBD system must monitor:

3.4.1.1. 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.

3.4.1.2. all other engine or exhaust aftertreatment 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 the table in Article 4(3) of this Directive. 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.

3.4.1.3. any other emission-related engine or exhaust aftertreatment component or system connected to an electronic control unit must be monitored for electrical disconnection unless otherwise monitored.

3.4.1.4. In the case of engines equipped with an aftertreatment 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 Annex II to Directive 2005/55/EC

— reagent consumption and dosing activity

according to section 6.5.4 of Annex I to Directive 2005/55/EC.

3.5. OBD operation and temporary disablement of certain OBD monitoring capabilities

3.5.1. The OBD system must be so designed, constructed and installed in a vehicle as to enable it to comply with the requirements of this Annex during the conditions of use defined in section 6.1.5.4 of Annex I to Directive 2005/55/EC.

Outside these normal operating conditions the emission control system may show some degradation in OBD system performance such that the thresholds given in the table in Article 4(3) of this Directive 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:

3.5.1.1. 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.

3.5.1.2. 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 Annex I to Directive 2005/55/EC.

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

3.5.1.4. 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.

3.5.1.5. 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).

3.5.1.6. The affected OBD monitoring systems may be disabled temporarily outside the conditions of use defined in section 6.1.5.4 of Annex I to Directive 2005/55/EC when this disablement can be justified by a limitation of the OBD monitoring (including modelling) capability.

3.5.2. 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.

3.6. Activation of malfunction indicator (MI)

3.6.1. The OBD system must incorporate a malfunction indicator readily visible to the vehicle operator. Except in the case of section 3.6.2 of this Annex, 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 deNO_x system). The use of red for the MI is prohibited.

3.6.2. 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.

3.6.3. 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.

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

3.6.5. 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[(2)] in addition to MI activation.

3.6.6. 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.

3.7. 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 permanent 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 3.4.1.1 and 3.4.1.3 of this Annex.

3.7.1. 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 3.5.1.2 of this Annex, readiness for the subject monitoring system may be set to 'ready' status without monitoring having been completed.

3.7.2. 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 Annex.

3.8. Extinguishing the MI

3.8.1. 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.

3.8.2. 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.

3.8.3. In the case of MI activation due to incorrect reagent consumption and dosing activity, the MI may be switched back to the previous state of activation if the conditions given in section 6.5.4 of Annex I to Directive 2005/55/EC no longer apply.

3.9. Erasing a fault code

3.9.1. 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 3.9.2.

3.9.2. From 1 October 2006 for new type approvals and from 1 October 2007 for all registrations, in the case of a fault code being generated according to sections 6.5.3 or 6.5.4 of Annex I to Directive 2005/55/EC, the OBD system shall retain a record of the fault code and the hours run by the engine during the MI activation for at least 400 days or 9 600 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 Annex.

(**1**) Symbol numbers F01 or F22.

(**2**) Symbol number F24.