UNITED NATIONS **E**

Economic and Social Council

Distr.
GENERAL

ECE/TRANS/WP.29/2006/125
17 July 2006

Original: ENGLISH

ECONOMIC COMMISSION FOR EUROPE

INLAND TRANSPORT COMMITTEE

World Forum for Harmonization of Vehicle Regulations (WP.29)

One-hundred-and-fortieth session
Geneva, 14-17 November 2006
Item 4.2.33. of the provisional agenda

PROPOSAL FOR SUPPLEMENT 2 TO THE 04 SERIES OF AMENDMENTS TO REGULATION No. 49

(Emissions of C.I., NG, and P.I. (LPG) engines)

Submitted by the Working Party on Pollution and Energy (GRPE)

Note: The text reproduced below was adopted by GRPE at its fifty-second session. It is based on document ECE/TRANS/WP.29/GRPE/2006/16, as amended by para. 19 to the report. It is submitted to WP.29 and AC.1 for consideration and vote. (ECE/TRANS/WP.29/GRPE/52, para. 19).

A. PROPOSAL

Add a new Annex 11, to read:

"Annex 11

TECHNICAL REQUIREMENTS FOR ON-BOARD DIAGNOSTIC SYSTEMS (OBD) FOR DIESEL ENGINES OF ROAD VEHICLES (WWH-OBD)

1. APPLICABILITY

This annex is not applicable, for the time being, for the purpose of type approval according to this Regulation. It will be made applicable in the future.

2. Reserved 1/.

3. DEFINITIONS

3.1. "Alert system" means a system on-board the vehicle which informs the driver of the vehicle or any other interested party that the OBD system has detected a malfunction.

3.2. "Approval authority" means the authority that grants the compliance approval of an OBD system considered by this annex. Per extension, it means also the technical service that has been accredited to evaluate the technical compliance of the OBD system.

3.3. "Calibration verification number" means the number that is calculated and reported by the engine system to validate the calibration/software integrity.

3.4. "Component monitoring" means the monitoring of input components for electrical circuit failures and rationality failures and monitoring of output components for electrical circuit failures and functionality failures. It refers to components that are electrically connected to the controller(s) of the engine system.

3.5. "Confirmed and active DTC" means a DTC that is stored during the time the OBD system concludes that a malfunction exists.

1/ The numbering of this annex is consistent with the numbering of the draft gtr on WWH-OBD. However, some paragraphs of the WWH-OBD gtr are not needed in this annex.

3.6. "Continuous-MI" means the malfunction indicator showing a steady indication at all times while the key is in the on (run) position with the engine running (ignition on - engine on).

3.7. "Deficiency" means an OBD monitoring strategy or other OBD feature that does not meet all the detailed requirements of this annex.

3.8. "Diagnostic trouble code (DTC)" means a numeric or alphanumeric identifier which identifies or labels a malfunction.

3.9. "Electrical circuit failure" means a malfunction (e.g. open circuit or short circuit) that leads to the measured signal (i.e. voltages, currents, frequencies, etc.) being outside the range where the transfer function of the sensor is designed to operate.

3.10. "Emission OBD family" means a manufacturer's grouping of engine systems having common methods of monitoring/diagnosing emission-related malfunctions.

3.11. "Emission threshold monitoring" means monitoring of a malfunction that leads to an excess of the OTLs. It consists of:

(a) direct emissions measurement via a tailpipe emissions sensor(s) and a model to correlate the direct emissions to test-cycle specific emissions; and/or

(b) indication of an emissions increase via correlation of computer input/output information to test-cycle specific emissions.

3.12. "Engine system" means the engine as it would be configured when tested for its exhaust emissions on a approval test-bed, including:

(a) the engine's electronic management controller(s);

(b) the exhaust after-treatment system(s);

(c) any emission-related component of the engine or the exhaust system which supplies input to, or receives output from, the engine's electronic management controller(s); and

(d) the communication interface (hardware and messages) between the engine's electronic management controller(s) and any other power train or vehicle control unit if the exchanged information has an influence on the control of emissions.

3.13. "Functionality failure" means a malfunction where an output component does not respond to a computer command in the expected way.

3.14. "Malfunction emission control strategy (MECS)" means a strategy within the engine system that is activated as a result of an emission-related malfunction.

3.15. "Malfunction indicator (MI)" is an indicator which clearly informs the driver of the vehicle in the event of a malfunction. The MI is part of the alert system (see "continuous-MI", "on-demand-MI", and "short-MI").

3.16. "Malfunction" means a failure or deterioration of an engine system, including the OBD system, that may lead either to an increase in any of the regulated pollutants emitted by the engine system or to a reduction in the effectiveness of the OBD system.

3.17. "MI status" means the command status of the MI, being either continuous-MI, Short-MI, on-demand-MI, or off.

3.18. "Monitoring" (see "emission threshold monitoring", "performance monitoring", and "total functional failure monitoring")

3.19. "OBD test-cycle" means the cycle over which an engine system is operated on an engine test-bed to evaluate the response of an OBD system to the presence of a qualified deteriorated component.

3.20. "OBD-parent engine system" means an engine system that has been selected from an emission-OBD family for which most of its OBD elements of design are representative of that family.

3.21. "On-board diagnostic system (OBD)" means a system on-board a vehicle or engine which has the capability:

(a) of detecting malfunctions, affecting the emission performance of the engine system;
(b) of indicating their occurrence by means of an alert system;
(c) of identifying the likely area of the malfunctions by means of information stored in computer memory and/or communicating that information off-board.

3.22. "On-demand-MI" means the malfunction indicator showing a steady indication in response to a manual demand from the driving position when the key is in the on (run) position with the engine off (ignition on - engine off).

3.23. "Operating sequence" means a sequence consisting of an engine start-up, an operating period, an engine shut-off, and the time until the next start-up, where a specific OBD monitor runs to completion and a malfunction would be detected if present.

3.24. "Pending DTC" means a DTC that is stored by the OBD system because a monitor has detected a situation where a malfunction may be present during the current or last completed operating sequence.

3.25. "Performance monitoring" means malfunction monitoring that consists of functionality checks and monitoring parameters that are not correlated to emission thresholds. Such monitoring is typically done on components or systems to verify that they are operating within the proper range (e.g. differential pressure in case of a DPF).

3.26. "Potential DTC" means a DTC that is stored by the OBD system because a monitor has detected a situation where a malfunction may be present but requires further evaluation to be confirmed. A potential DTC is a pending DTC which is not a confirmed and active DTC.

3.27. "Previously active DTC" means a formerly confirmed and active DTC that remains stored after the OBD system has concluded that the malfunction that caused the DTC is no longer present.

3.28. "Qualified deteriorated component or system (QDC)"means a component or system that

has been intentionally deteriorated (e.g. accelerated aging) and/or manipulated in a controlled manner and which has been accepted by the authorities according to the provisions set in this annex.

3.29. "Rationality failure" means a malfunction where the signal from an individual sensor or component is at variance with that expected when assessed against signals available from other sensors or components within the control system. Rationality failures include malfunctions that lead to the measured signal (i.e. voltages, currents, frequencies, etc.) being inside the range where the transfer function of the sensor is designed to operate.

3.30. "Readiness" means a status indicating whether a monitor or a group of monitors have run since the last erasing by request of an external OBD scan-tool.

3.31. "Scan-tool" means an external test equipment used for standardised off-board communication with the OBD system in accordance with the requirements of this annex.

3.32. "Short-MI" means the malfunction indicator showing a steady indication from the time the key is moved to on (run) position and the engine is started (ignition on - engine on) and extinguishing after 15 seconds or the key is moved to off, whichever occurs first.

3.33. "Software calibration identification" means a series of alphanumeric characters that identifies the emission-related calibration / software version(s) installed in the engine system.

3.34. "Total functional failure monitoring" means monitoring a malfunction which is leading to a complete loss of the desired function of a system.

3.35. "Warm-up cycle" means sufficient engine operation such that the coolant temperature has risen by at least 295 K (22 °C / 40 °F) from engine starting and reaches a minimum temperature of 333 K (60 °C / 140 °F) 2/.

3.36. Abbreviations

CV	Crankcase Ventilation
DOC	Diesel Oxidation Catalyst
DPF	Diesel Particulate Filter or Particulate Trap including catalyzed DPFs and Continuously Regenerating Traps (CRT)
DTC	Diagnostic trouble code
EGR	Exhaust Gas Recirculation
HC	Hydrocarbon
LNT	Lean NO_x Trap (or NO_x absorber)
MECS	Malfunction Emission Control Strategy
NO_x	Oxides of Nitrogen
OTL	OBD Threshold Limit
PM	Particulate Matter
SCR	Selective Catalytic Reduction

2/ This definition does not imply that a temperature sensor is necessary to measure the coolant temperature.

SW	Screen Wipers
TFF	Total Functional Failure monitoring
VGT	Variable Geometry Turbocharger
VVT	Variable Valve Timing

4. GENERAL REQUIREMENTS

In the context of this annex, the OBD system shall have the capability of detecting In malfunctions, of indicating their occurrence by means of a malfunction indicator, of identifying the likely area of the malfunctions by means of information stored in computer memory, and communicating that information off-board.

The OBD system shall be designed and constructed so as to enable it to identify types of malfunctions over the complete life of the vehicle/engine. In achieving this objective, the administrative department will recognize that engines which have been used in excess of their regulatory useful life may show some deterioration in OBD system performance and sensitivity such that the OBD thresholds may be exceeded before the OBD system signals a malfunction to the driver of the vehicle.

The above paragraph does not extend the engine manufacturer's compliance liability for an engine beyond its regulated useful life (i.e. the time or distance period during which emission standards or emission limits continue to apply).

4.1. Application for approval of an OBD system

4.1.1. Primary approval

The manufacturer of an engine system may apply for the approval of its OBD system in one of the three following manners:

(a) The manufacturer of an engine system applies for the approval of an individual OBD system by demonstrating that OBD system complies with all the provisions of this annex.

(b) The manufacturer of an engine system applies for the approval of an emission-OBD family by demonstrating that the OBD-parent engine system of the family complies with all the provisions of this annex.

The manufacturer of an engine system applies for the approval of an OBD system by demonstrating that OBD system meets the criteria for belonging to an emission-OBD family that has already been certified.

4.1.2. Extension / Modification of an existing certificate

4.1.2.1. Extension to include a new engine system into an emission-OBD family

At the request of the manufacturer and upon approval of the administrative department, a new engine system may be included as a member of a certified emission-OBD family if all the engine systems within the so-extended emission-OBD family still have

common methods of monitoring / diagnosing emission-related malfunctions.

If all OBD elements of design of the OBD-parent engine system are representative of those of the new engine system, then the OBD-parent engine system shall remain unchanged and the manufacturer shall modify the documentation package according to paragraph 8 of this annex.

If the new engine system contains elements of design that are not represented by the OBD-parent engine system but itself would represent the whole family, then the new engine system shall become the new OBD-parent engine system. In this case the new OBD elements of design shall be demonstrated to comply with the provisions of this annex, and the documentation package shall be modified according to paragraph 8. of this annex.

4.1.2.2. Extension to address a design change that affects the OBD system

At the request of the manufacturer and upon approval of the administrative department, an extension of an existing certificate may be granted in the case of a design change of the OBD system if the manufacturer demonstrates that the design changes comply with the provisions of this annex.

The documentation package shall be modified according to paragraph 8. of this annex.

If the existing certificate applies to an emission-OBD family, the manufacturer shall justify to the administrative department that the methods of monitoring/diagnosing emission-related malfunctions are still common within the family and that the OBD-parent engine system remains representative of the family.

4.1.2.3. Certificate modification to address a malfunction reclassification

This paragraph applies when, following a request by the authority that granted the approval, or at its own initiative, the manufacturer applies for a modification of an existing certificate in order to reclassify one or several malfunctions.

The compliance of the new classification shall then be demonstrated according to the provisions of this annex and the documentation package shall be modified according to paragraph 8 of this annex.

4.2. Monitoring requirements

All emission-related components and systems included in an engine system shall be monitored by the OBD system in accordance with the requirements set in appendix 3. However, the OBD system is not required to use a unique monitor to detect each malfunction referred to in appendix 3.

The OBD system shall also monitor its own components.

The items of appendix 3 list the systems or components required to be monitored by the OBD system and describes the types of monitoring expected for each of these components or systems (i.e. emission threshold monitoring, performance monitoring, total functional failure monitoring, or component monitoring).

The manufacturer can decide to monitor additional systems and components.

4.2.1. Selection of the monitoring technique

Approval authorities may approve a manufacturer's use of another type of monitoring technique than the one mentioned in appendix 3. The chosen type of monitoring shall be shown by the manufacturer, to be robust, timely and efficient (i.e. through either technical considerations, test results, previous agreements, etc.).

In case a system and / or component is not covered by appendix 3 the manufacturer shall submit for approval to the administrative department an approach to monitoring. The administrative department will approve the chosen type of monitoring and monitoring technique (i.e. emission threshold monitoring, performance monitoring, total functional failure monitoring, or component monitoring) if it has been shown by the manufacturer, by reference to those detailed in appendix 3, to be robust, timely and efficient (i.e. through either technical considerations, test results, previous agreements, etc.).

4.2.1.1. Correlation to actual emissions

In the case of emission threshold monitoring, a correlation to test-cycle specific emissions shall be required. This correlation would typically be demonstrated on a test engine in a laboratory setting.

In all other monitoring cases (i.e. performance monitoring, total functional failure monitoring, or component monitoring), no correlation to actual emissions is necessary. However, the administrative department may request test data to verify the classification of the malfunction effects as described in paragraph 6.2. of this annex.

Examples:

An electrical malfunction may not require a correlation because this is a yes/no malfunction. A DPF malfunction monitored via delta pressure may not require a correlation because it anticipates a malfunction.

If the manufacturer demonstrates, according to the demonstration requirements of this annex, that emissions would not exceed the OBD threshold limits upon total failure or removal of a component or system, a performance monitoring of this component or system shall be accepted.

When a tailpipe emission sensor is used for monitoring the emissions of a specific pollutant all other monitors may be exempted from further correlation to the actual emissions of that pollutant. Nevertheless, such exemption shall not preclude the need to

include these monitors, using other monitoring techniques, as part of the OBD system as the monitors are still needed for the purpose of malfunction isolation.

A malfunction shall always be classified according to paragraph 4.5. based on its impact on emissions, regardless of the type of monitoring used to detect the malfunction.

4.2.2. Component monitoring (input/output components/systems)

In the case of input components that belong to the engine system, the OBD system shall at a minimum detect electrical circuit failures and, where feasible, rationality failures.

The rationality failure diagnostics shall then verify that a sensor output is neither inappropriately high nor inappropriately low (i.e. there shall be "two-sided" diagnostics).

To the extent feasible, and with the agreement of the administrative department, the OBD system shall detect separately, rationality failures (e.g. inappropriately high and inappropriately low), and electrical circuit failures (e.g. out-of-range high and out-of-range low). Additionally, unique DTCs for each distinct malfunction (e.g. out-of-range low, out-of-range high and rationality failure) shall be stored.

In the case of output components that belong to the engine system, the OBD system shall at a minimum detect electrical circuit failures, and, where feasible, if the proper functional response to computer commands does not occur.

To the extent feasible, and with the agreement of the administrative department, the OBD system shall detect separately functionality failures, electrical circuit failures (e.g. out-of-range high and out-of-range low) and store unique DTCs for each distinct malfunction (e.g. out-of-range low, out-of-range high, functionality failure).

The OBD system shall also perform rationality monitoring on the information coming from or provided to components that do not belong to the engine system when this information compromises the emission control system and/or the engine system for proper performance.

4.2.2.1. Exception to component monitoring

Monitoring of electrical circuit failures, and to the extent feasible, functionality, and rationality failures of the engine system shall not be required if all the following conditions are met:

(a) the failure results in an emission increase of any pollutant of less than 50 per cent of the regulated emission limit, and

(b) the failure does not cause any emission to exceed the regulated emission limit 3/, and

(c) the failure does not affect a component or system enabling the proper performance of the OBD system.

Determination of the emissions impact shall be performed on a stabilized engine system in an engine dynamometer test cell, according to the demonstration procedures of this annex.

4.2.3. Monitoring frequency

Monitors shall run continuously, at any time where the monitoring conditions are fulfilled, or once per operating sequence (e.g. for monitors that lead to an increase of emission when it runs).

When a monitor does not run continuously, the manufacturer shall clearly inform the administrative department and describe the conditions under which the monitor runs.

The monitors shall run during the applicable OBD test-cycle as specified in paragraph 7.2.2.

A monitor shall be regarded as running continuously, if it runs at a rate not less than once per second. If a computer input or output component is sampled less frequently than one sample per second for engine control purpose, a monitor shall also regarded as running continuously, if the signal of the component is evaluated each time sampling occurs.

For components or systems monitored continuously, it is not required to activate an output component/system for the sole purpose of monitoring that output component/system.

4.3. Requirements for recording OBD information

When a malfunction has been detected but is not yet confirmed, the possible malfunction shall be considered as a "Potential DTC" and accordingly a "Pending DTC" status shall be recorded. A "Potential DTC" shall not lead to an activation of the alert system according to paragraph 4.6.

Within the first operating sequence, a malfunction may be directly considered "confirmed and active" without having been considered a "potential DTC". It shall be given the "Pending DTC" and a "confirmed and active DTC" status.

In case a malfunction with the previously active status occurs again, that malfunction

3/ The measured value shall be considered taking into account the relevant precision tolerance of the test-cell system and the increased variability in the test results due to the malfunction.

may at the choice of manufacturer be directly given the "Pending DTC " and "confirmed and active DTC" status. Without having been given the "potential DTC" status. If that malfunction is given the potential status, it shall also keep the previously active status during the time it is not yet confirmed or active.

The monitoring system shall conclude whether a malfunction is present before the end of the next operating sequence following its first detection. At this time, a "confirmed and active" DTC shall be stored and the alert system be activated according to paragraph 4.6.

In case of a recoverable MECS (i.e. the operation automatically returns to normal and the MECS is de-activated at the next engine ON), a "confirmed and active" DTC need not be stored unless the MECS is again activated before the end of the next operating sequence. In case of a non-recoverable MECS, a "confirmed and active" DTC shall be stored as soon as the MECS is activated.

In some specific cases where monitors need more than two operating sequences to accurately detect and confirm a malfunction (e.g. monitors using statistical models or with respect to fluid consumption on the vehicle), the administrative department may permit the use of more than two operating sequences for monitoring provided the manufacturer justifies the need for the longer period (e.g. by technical rationale, experimental results, in house experience, etc.).

When a confirmed and active malfunction is no longer detected by the system during a complete operating sequence, it shall be given the previously active status by the start of the next operating sequence and keep that status until this malfunction is erased by a scan tool or erased from the computer memory according to paragraph 4.4.

Note: The requirements prescribed in this paragraph are illustrated in appendix 2 .

4.4. Requirements for erasing OBD information

DTC and the applicable information (inclusive the associated freeze frame) shall not be erased by the OBD system itself from the computer memory until that DTC has been in the previously active status for at least 40 warm-up cycles or 200 engine operating hours, whichever occurs first. The OBD system shall erase all the DTCs and the applicable information (inclusive the associated freeze frame) upon request of a scan tool or a maintenance tool.

4.5. Requirements for malfunction classification

Malfunction classification specifies the class to which a malfunction is assigned when such a malfunction is detected, according to the requirements of paragraph 4.2. of this annex.

A malfunction shall be assigned to one class for the actual life of the vehicle unless the authority that granted the certificate or the manufacturer determines that reclassification

of that malfunction is necessary.

If a malfunction would result in a different classification for different regulated pollutant emissions or for its impact on other monitoring capability, the malfunction shall be assigned to the class that takes precedence in the discriminatory display strategy.

If an MECS is activated as a result of the detection of a malfunction, this malfunction shall be classified based on either the emission impact of the activated MECS or its impact on other monitoring capability. The malfunction shall then assigned to the class that takes precedence in the discriminatory display strategy.

4.5.1. Class A malfunction

A malfunction shall be identified as Class A when the relevant OBD threshold limits (OTLs) are assumed to be exceeded.

It is accepted that the emissions may not be above the OTLs when this class of malfunction occurs.

4.5.2. Class B1 malfunction

A malfunction shall be identified as Class B1 where circumstances exist that have the potential to lead to emissions being above the OTLs but for which the exact influence on emission cannot be estimated and thus the actual emissions according to circumstances may be above or below the OTLs.

Examples of Class B1 malfunctions may include malfunctions detected by monitors that infer emission levels based on readings of sensors or restricted monitoring capability.

Class B1 malfunctions shall include malfunctions that restrict the ability of the OBD system to carry out monitoring of Class A or B1 malfunctions.

4.5.3. Class B2 malfunction

A malfunction shall be identified as Class B2 when circumstances exist that are assumed to influence emissions but not to a level that exceeds the OTL.

Malfunctions that restrict the ability of the OBD system to carry out monitoring of Class B2 malfunctions of shall be classified into Class B1 or B2.

4.5.4. Class C malfunction

A malfunction shall be identified as Class C when circumstances exist that, if monitored, are assumed to influence emissions but to a level that would not exceed the regulated emission limits.

Malfunctions that restrict the ability of the OBD system to carry out monitoring of

Class C malfunctions shall be classified into Class B1 or B2.

4.6. Alert system

The failure of a component of the alert system shall not cause the OBD system to stop functioning.

4.6.1. MI specification

The malfunction indicator shall be perceptible by the driver from the driver's seat position under all lighting conditions. The malfunction indicator shall comprise a yellow (as defined in Annex 5 to UNECE Regulation No. 7) or amber (as defined in Annex 5 to UNECE Regulation No. 6) warning signal identified by the F01 symbol in accordance with ISO Standard 2575:2004.

4.6.2. MI illumination schemes

Depending on the malfunction(s) detected by the OBD system, the MI shall be illuminated according to one of the activation modes described in the following table

	Activation mode 1	Activation mode 2	Activation mode 3	Activation mode 4
Conditions of activation	No malfunction	Class C malfunction	Class B malfunction and B1 counters < 200 h	Class A malfunction or B1 counter > 200 h
Key on engine on	No display	Discriminatory display strategy	Discriminatory display strategy	Discriminatory display strategy
Key on engine off	Harmonized display strategy	Harmonized display strategy	Harmonized display strategy	Harmonized display strategy

The display strategy requires the MI to be activated according to the class in which a malfunction has been classified. This strategy shall be locked by software coding that shall not be routinely available via the scan tool.

The MI activation strategy at key on, engine off is described in paragraph 4.6.4.

Figures B1 and B2 illustrate the prescribed activation strategies at key on, engine on or off.

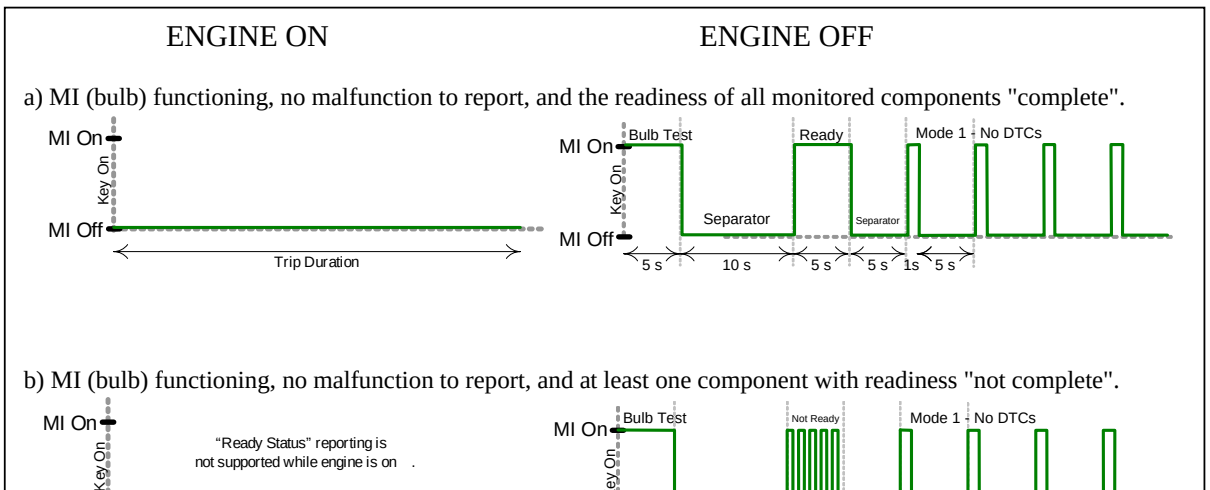


Figure B1
Bulb test and readiness indication

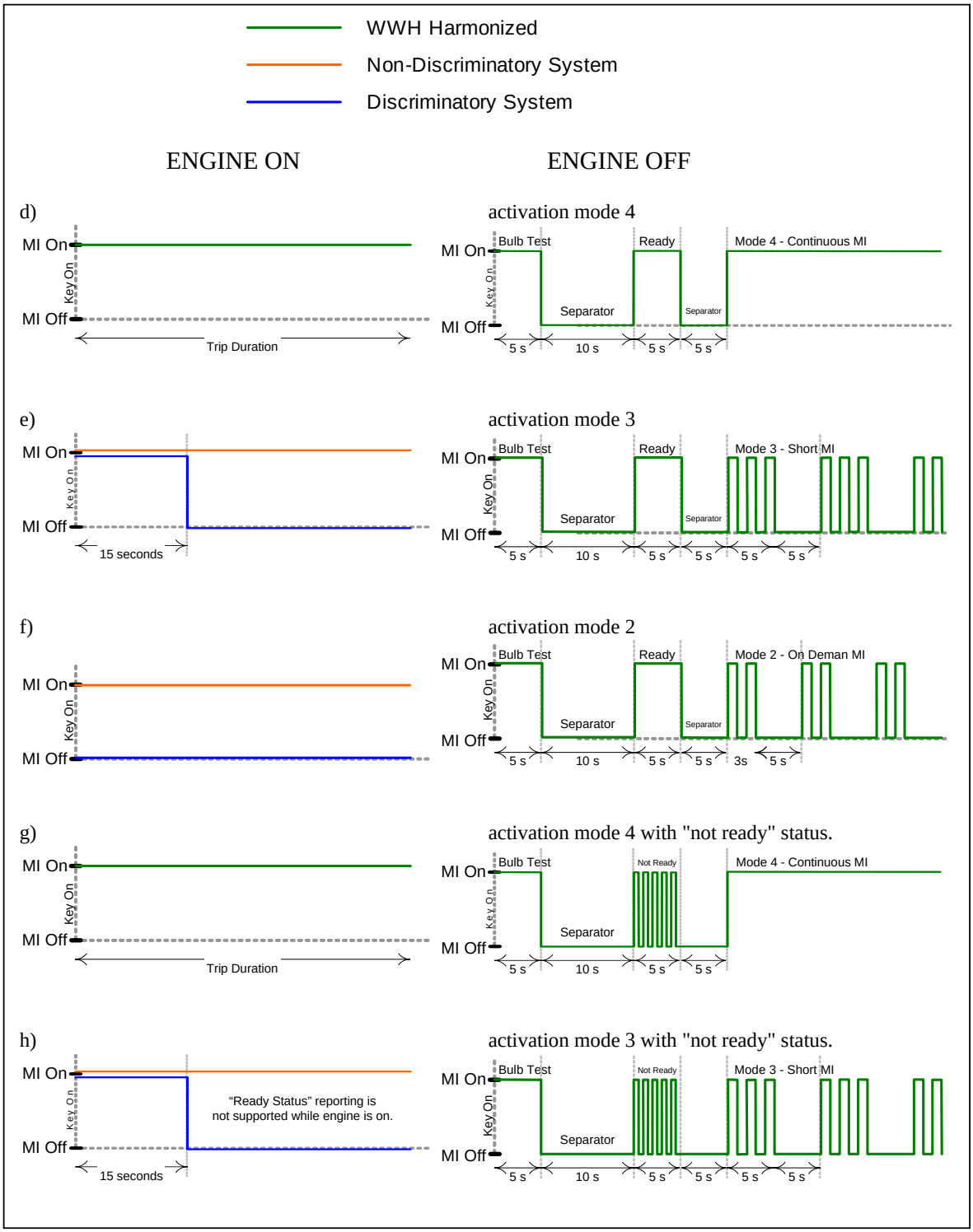


Figure B2:
Malfunction display strategy: only the discriminatory strategy is applicable

4.6.3. MI activation at "engine on"

When the key is placed in the on position and the engine is started (engine on), the MI shall be commanded off unless the provisions of paragraph 4.6.3.1. and/or paragraph 4.6.3.2. have been met.

4.6.3.1. MI display strategy

For the purpose of activating the MI, continuous-MI shall take precedence to short-MI and on-demand-MI. For the purpose of activating the MI, short-MI shall take precedence to on-demand-MI.

4.6.3.1.1. Class A malfunctions

The OBD system shall command a continuous-MI upon storage of a confirmed DTC associated with a Class A malfunction.

4.6.3.1.2. Class B malfunctions

The OBD system shall command a "short-MI" at the next key-on event following storage of a confirmed and active DTC associated with a Class B malfunction.

Whenever a B1 counter reaches 200 hours, the OBD system shall command a continuous-MI.

4.6.3.1.3. Class C malfunctions

The manufacturer may make available information on Class C malfunctions through the use of an on-demand-MI that shall be available until the engine is started.

4.6.3.1.4. MI de-activation scheme

The "continuous-MI" shall switch to a "short-MI" if a single monitoring event occurs and the malfunction that originally activated the continuous-MI is not detected during the current operating sequence and a continuous-MI is not activated due to another malfunction.

The "short-MI" shall be deactivated if the malfunction is not detected during 3 subsequent sequential operating sequences and the MI is not activated due to another Class A or B malfunction.

4.6.4. MI activation at key-on/engine-off

The MI activation at key-on/engine-off shall consist of two sequences separated by a 5 seconds MI off:

(a) the first sequence is designed to provide an indication of the MI functionality and the readiness of the monitored components;

(b) the second sequence is designed to provide an indication of the presence of a malfunction.

The second sequence is repeated until engine is started (engine-on) or the key set on key-off position.

4.6.4.1. MI functionality/readiness

The MI shall show a steady indication for 5 seconds to indicate that the MI is functional.

The MI shall remain at the off position for 10 seconds.

The MI shall then remain at the on position for 5 seconds to indicate that the readiness for all monitored components is complete.

The MI shall blink once per second for 5 seconds to indicate that the readiness for one or more of the monitored components is not complete.

The MI shall then remain off for 5 seconds.

4.6.4.2. Presence / absence of a malfunction

Following the sequence described in paragraph 4.6.4.1, the MI shall indicate the presence of a malfunction by a series of flashes or a continuous illumination, depending on the applicable activation mode, as described in the following paragraphs, or absence of a malfunction by a series of single flashes. When applicable, each flash consists of a 1s MI-on followed by a 1s MI-off, and the series of flashes will be followed by a period of 5 seconds with the MI off.

Four activation modes are considered, where activation mode 4 shall take precedence over activation modes 1, 2 and 3, activation mode 3 shall take precedence over activation modes 1 and 2, and activation mode 2 shall take precedence over activation mode 1.

4.6.4.2.1. Activation mode 1 - absence of malfunction

The MI shall blink for one flash.

4.6.4.2.2. Activation mode 2 - "On-demand-MI"

The MI shall show blink for two flashes if the OBD system would command an on-demand-MI according to the discriminatory display strategy described in paragraph 4.6.3.1.

4.6.4.2.3. Activation mode 3 - "short-MI"

The MI shall blink for three flashes if the OBD system would command a short-MI according to the discriminatory display strategy described in paragraph 4.6.3.1.

4.6.4.2.4. Activation mode 4 - "continuous-MI"

The MI shall remain continuously ON ("continuous-MI") if the OBD system would command a continuous-MI according to the discriminatory display strategy described in paragraph 4.6.3.1.

4.6.5. Counters associated with malfunctions

4.6.5.1. MI counters

4.6.5.1.1. Continuous-MI Counter

The OBD system shall contain a continuous-MI counter to record the number of hours during which the engine has been operated while a continuous-MI is activated.

The continuous-MI counter shall count up to the maximum value provided in a 2 byte counter with 1 hour resolution and hold that value unless the conditions allowing the counter to be reset to zero are met.

The continuous-MI counter shall operate as follows:

(a) if starting from zero, the continuous-MI counter shall begin counting as soon as a continuous-MI is activated;

(b) the continuous-MI counter shall halt and hold its present value when the continuous-MI is no longer activated;

(c) the continuous-MI counter shall continue counting from the point at which it had been held if a malfunction that results in a continuous-MI is detected within 3 operating sequences;

(d) the continuous-MI counter shall start again counting from zero when a malfunction that results in a continuous-MI is detected after 3 operating sequences since the counter was last held;

(e) the continuous-MI counter shall be reset to zero when:

  (i) no malfunction that results in a continuous-MI is detected during 40 warm-up cycles or 200 engine operating hours since the counter was last held whichever occurs first; or

  (ii) the OBD scan tool commands the OBD System to clear OBD information.

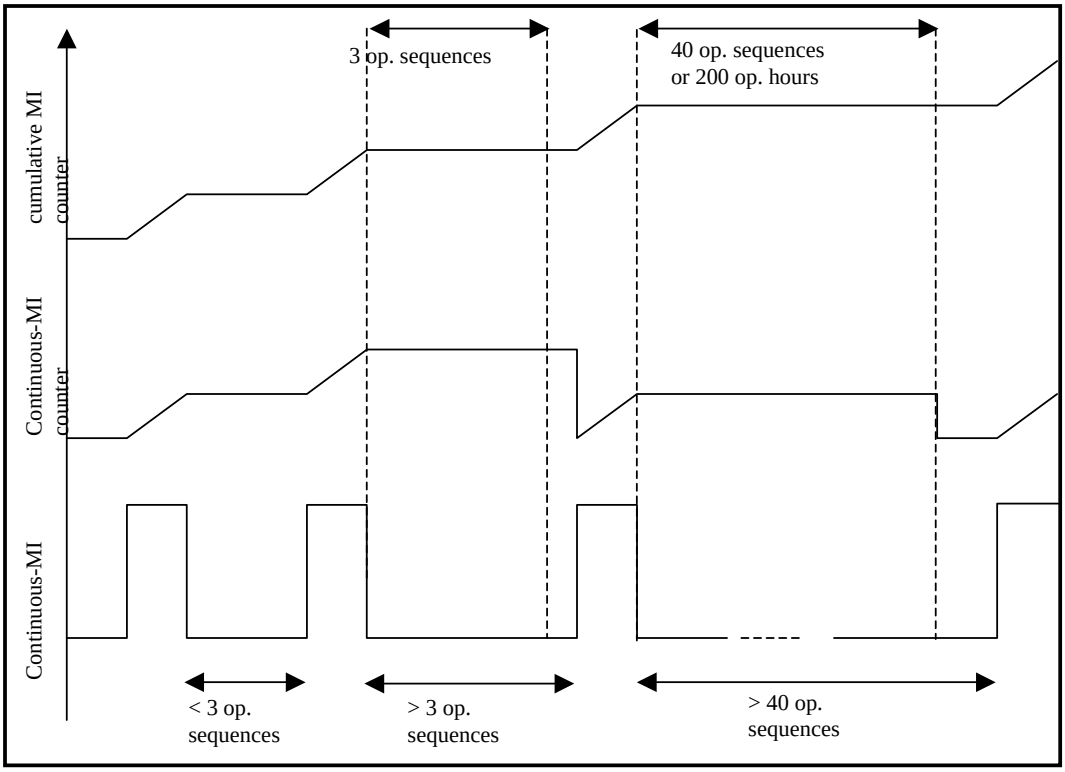


Figure C1:
Illustration of the MI counters activation principles

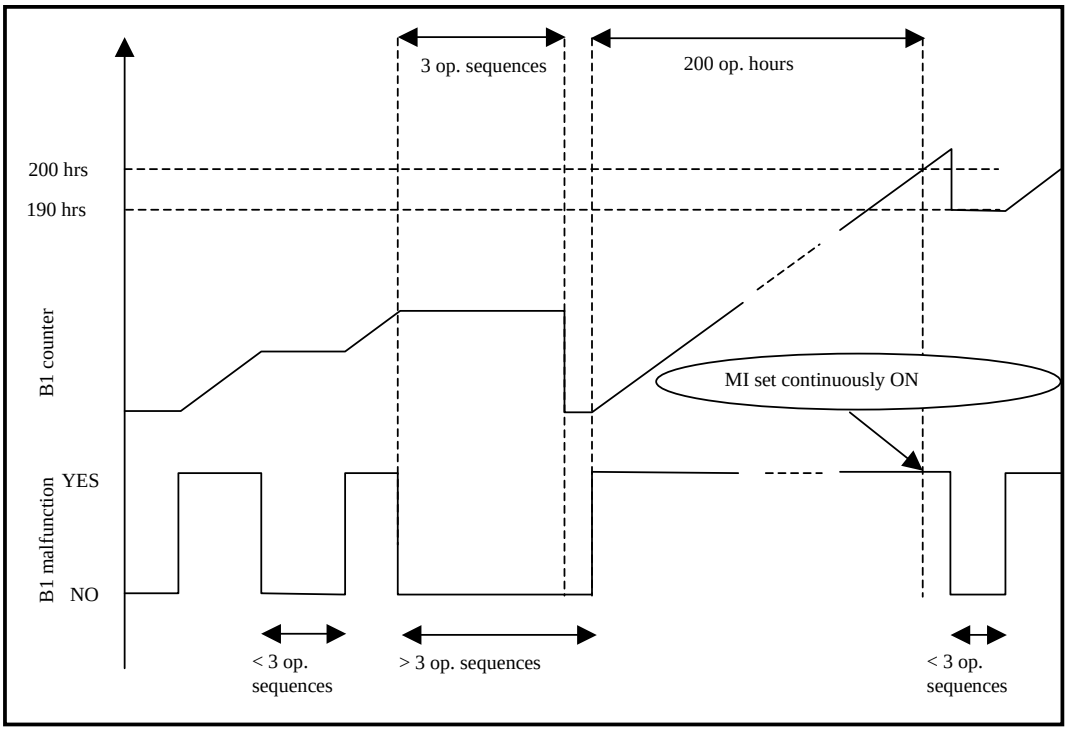


Figure C2:

Illustration of the B1 counter activation principles

4.6.5.1.2. Cumulative continuous-MI counter

The OBD system shall contain a cumulative continuous-MI counter to record the cumulative number of hours during which the engine has been operated over its life while a continuous-MI is activated.

The cumulative continuous-MI counter shall count up to the maximum value provided in a 2-byte counter with 1 hour resolution and hold that value.

The cumulative continuous-MI counter shall not be reset to zero by the engine system, a scan tool or a disconnection of a battery.

The cumulative continuous-MI counter shall operate as follows:

(a) the cumulative continuous-MI counter shall begin counting when the continuous-MI is activated.

(b) the cumulative continuous-MI counter shall halt and hold its present value when the continuous-MI is no longer activated.

(c) the cumulative continuous-MI counter shall continue counting from the point it had been held when a continuous-MI is activated.

Figure C1 illustrates the principle of the cumulative continuous-MI counter and appendix 2 contains examples that illustrate the logic.

4.6.5.2. Counters associated with Class B1 malfunctions

4.6.5.2.1. Single B1-counter

The OBD system shall contain a B1 counter to record the number of hours during which the engine has operated while a Class B1 malfunction is present.

The B1 counter shall operate as follows:

(a) the B1 counter shall begin counting as soon as a Class B1 malfunction is detected and a confirmed and active DTC has been stored.

(b) the B1 counter shall halt and hold its present value if no Class B1 malfunction is confirmed and active, or when all Class B1 malfunction have been erased by a scan tool.

(c) the B1 counter shall continue counting from the point it had been held if a subsequent Class B1 malfunction is detected within 3 operating sequences.

In the case where the B1 counter has exceeded 200 engine running hours, the OBD system shall set the counter to 190 engine running hours when the OBD system has determined that a Class B1 malfunction is no longer confirmed and active, or when all Class B1 malfunctions have been erased by a scan tool. The B1 counter shall begin counting from 190 engine running hours if a subsequent Class B1 malfunction is present within 3 operating sequences.

The B1 counter shall be reset to zero when three consecutive operating sequences have

occurred during which no Class B1 malfunctions have been detected.

Note: The B1 counter does not indicate the number of engine running hours with a single Class B1 malfunction present.

The B1 counter may accumulate the number of hours of 2 or more different Class B1 malfunctions, none of them having reached the time the counter indicates.

The B1 counter is only intended to determine when the continuous-MI shall be activated.

Figure C2 illustrates the principle of the B1 counter and appendix 2 contains examples that illustrate the logic.

4.6.5.2.2. Multiple B1-counters

A manufacturer may use multiple B1 counters. In that case the system shall be capable of assigning a specific B1 counter to each class B1 malfunction.

The control of the specific B1 counter shall follow the same rules as the single B1 counter, where each specific B1 counter shall begin counting when the assigned Class B1 malfunction is detected.

4.7. OBD information

4.7.1. Recorded information

The information recorded by the OBD system shall be available upon off-board request in the following packages manner:
(a) information about the engine state;
(b) information about active emission-related malfunctions;
(c) information for repair.

4.7.1.1. Information about the engine state

This information will provide an enforcement agency 4/ with the malfunction indicator status and associated data (e.g. continuous-MI counter, readiness).

The OBD system shall provide all information (according to the applicable standard set in appendix 6) for the external roadside check test equipment to assimilate the data and provide an enforcement agent with the following information:
(a) discriminatory/non-discriminatory display strategy;
(b) the VIN (vehicle identification number);
(c) presence of a continuous-MI;

4/ A typical use of this information package may be to establish basic emission road-worthiness of the engine system.

(d) the readiness of the OBD system;
(e) the number of engine operating hours during which a continuous-MI was last activated (continuous-MI counter).

This information shall be read only access (i.e. no clearing).

4.7.1.2. Information about active emission-related malfunctions

This information will provide any inspection station 5/ with a subset of engine related OBD data including the malfunction indicator status and associated data (MI counters), a list of active/confirmed malfunctions of classes A and B and associated data (e.g. B1-counter).

The OBD system shall provide all information (according to the applicable standard set in appendix 6) for the external inspection test equipment to assimilate the data and provide an inspector with the following information:
(a) the gtr (and revision) number, to be integrated into Regulation No. 49 type approval marking;
(b) discriminatory/ non-discriminatory display strategy;
(c) the VIN (vehicle identification number);
(d) the Malfunction Indicator status;
(e) the Readiness of the OBD system;
(f) number of warm-up cycles and number of engine operating hours since recorded OBD information was last cleared;
(g) the number of engine operating hours during which a continuous-MI was last activated (continuous-MI counter);
(h) the cumulated operating hours with a continuous-MI (cumulative continuous-MI counter);
(i) the value of the B1 counter with the highest number of engine operating hours;
(j) the confirmed and active DTCs for Class A malfunctions;
(k) the confirmed and active DTCs for Classes B (B1 and B2) malfunctions;
(l) the confirmed and active DTCs Class B1 malfunctions;
(m) the software calibration identification(s);
(n) the calibration verification number(s).

This information shall be read only access (i.e. no clearing).

4.7.1.3. Information for repair

This information will provide repair technicians with all OBD data specified in this annex (e.g. freeze frame information).

The OBD system shall provide all information (according to the applicable standard set in appendix 6) for the external repair test equipment to assimilate the data and provide a

5/ A typical use of this information package may be to establish detailed understanding of the emission road-worthiness of the engine system.

repair technician with the following information:

(a) gtr (and revision) number, to be integrated into Regulation No. 49 type approval marking;
(b) VIN (vehicle identification number);
(c) malfunction indicator status;
(d) readiness of the OBD system;
(e) number of warm-up cycles and number of engine operating hours since recorded OBD information was last cleared;
(f) monitor status (i.e. disabled for the rest of this drive cycle complete this drive cycle, or not complete this drive cycle) since last engine shut-off for each monitor used for readiness status;
(g) number of engine operating hours since the malfunction indicator has been activated (continuous MI counter);
(h) confirmed and active DTCs for Class A malfunctions;
(i) confirmed and active DTCs for Classes B (B1 and B2) malfunctions;
(j) cumulated operating hours with a continuous-MI (cumulative continuous-MI counter);
(k) value of the B1 counter with the highest number of engine operating hours;
(l) confirmed and active DTCs for Class B1 malfunctions and the number of engine operating hours from the B1-counter(s);
(m) confirmed and active DTCs for Class C malfunctions;
(n) pending DTCs and their associated class;
(o) previously active DTCs and their associated class;
(p) real-time information on OEM selected and supported sensor signals, internal and output signals (see paragraph 4.7.2 and appendix 5);
(q) freeze frame data requested by this annex (see paragraph 4.7.1.4. and appendix 5);
(r) software calibration identification(s);
(s) calibration verification number(s).

The OBD system shall clear all the recorded malfunctions of the engine system and related data (operating time information, freeze frame, etc.) in accordance with the provisions of this annex, when this request is provided via the external repair test equipment according to the applicable standard set in appendix 6.

4.7.1.4. Freeze frame information

At least one "freeze frame" of information shall be stored at the time that either a potential DTC or a confirmed and active DTC is stored at the decision of the manufacturer. The manufacturer is allowed to update the freeze frame information whenever the pending DTC is detected again.

The freeze frame shall provide the operating conditions of the vehicle at the time of malfunction detection and the DTC associated with the stored data. The freeze frame shall include the information as shown in table 1 in appendix 5 of this annex. The freeze frame shall also include all of the information in tables 2 and 3 of appendix 5 of this annex that are used for monitoring or control purposes in the specific control unit that stored the DTC.

Storage of freeze frame information associated with a Class A malfunction shall take precedence over information associated with a Class B1 malfunction which shall take precedence over information associated with a Class B2 malfunction and likewise for information associated with a Class C malfunction. The first malfunction detected shall take precedence over the most recent malfunction unless the most recent malfunction is of a higher class.

In case a device is monitored by the OBD system and is not be covered by appendix 5 the freeze frame information shall include elements of information for the sensors and actuators of this device in a way similar to those described in appendix 5. This shall be submitted for approval by the administrative department at the time of approval.

4.7.1.5. Readiness

A readiness shall be set to "complete" when a monitor or a group of monitors addressed by this status have run since the last erasing by request of an external OBD scan-tool. Readiness shall be set to "not complete" by erasing the fault code memory of a monitor or group of monitors by request of an external scan-tool.

Normal engine shutdown shall not cause the readiness to change.

The manufacturer may request, subject to approval by the administrative department, that the ready status for a monitor be set to indicate “complete” without the monitor having completed if monitoring is disabled for a multiple number of operating sequences due to the continued presence of extreme operating conditions (e.g. cold ambient temperatures, high altitudes). Any such request must specify the conditions for monitoring system disablement and the number of operating sequences that would pass without monitor completion before ready status would be indicated as "complete".

4.7.2 Data stream information

The OBD system shall make available to a scan tool in real time the information shown in tables 1 to 4 in appendix 5 of this annex, upon request (actual signal values should be used in favour of surrogate values).

For the purpose of the calculated load and torque parameters, the OBD system shall report the most accurate values that are calculated within the applicable electronic control unit (e.g. the engine control computer).

Table 1 in appendix 5 gives the list of mandatory OBD information relating to the

engine load and speed.

Table 2 in appendix 5 shows the other OBD information which must be included if used by the emission or OBD system to enable or disable any OBD monitors.

Table 3 in appendix 5 shows the information which is required to be included if the engine is so equipped, senses or calculates the information 6/. At the decision of the manufacturer, other freeze frame or data stream information may be included.

In case a device is monitored by the OBD system and is not covered by appendix 5 (e.g. SCR), the data-stream information shall include elements of information for the sensors and actuators of this device in a way similar to those described in appendix 5. This shall be submitted for approval by the administrative department at the time of approval.

4.7.3. Access to OBD information

Access to OBD information shall be provided only in accordance with the standards mentioned in appendix 6 of this annex and the following sub-paragraphs 7/.

Access to the OBD information shall not be dependent on any access code or other device or method obtainable only from the manufacturer or its suppliers. Interpretation of the OBD information shall not require any unique decoding information, unless that information is publicly available.

A single access method (e.g. a single access point/node) to OBD information shall be supported to retrieve all OBD information. This method shall permit access to the complete OBD information required by this annex. This method shall also permit access to specific smaller information packages as defined in this annex (e.g. road worthiness information packages in case of emission related OBD)

Access to OBD information shall be provided using, at least one of the following series of standards mentioned in appendix 6:

(a) ISO/PAS 27145 (CAN-based)
(b) ISO 27145 (TCP/IP-based)
(c) SAE J1939-71

Access to OBD information shall be possible by the means of a wired connection.

OBD data shall be provided by the OBD system upon request using scan tool that complies with the requirements of the applicable standards mentioned in appendix 6

6/ It is not required to equip the engine for the sole purpose of providing the information data mentioned in tables 2 and 3 of Annex 5.

7/ The manufacturer is allowed to use an additional on-board diagnostic display, such as a dashboard mounted video display device, for providing access to OBD information. Such an additional device is not subject to the requirements of this annex.

(communication with external tester).

4.7.3.1. CAN based wired communication

The communication speed on the wired data link of the OBD system shall be either 250 kbps or 500 kbps.

It is the manufacturer's responsibility to select the baud-rate and to design the OBD system according to the requirements specified in the standards mentioned in appendix 6, and referred to in this annex. The OBD system shall be tolerant against the automatic detection between these two baud-rates exercised by the external test equipment.

The connection interface between the vehicle and the external diagnostic test equipment (e.g. scan-tool) shall be standardised and shall meet all of the requirements of ISO 15031-3 Type A (12 VDC power supply), Type B (24 VDC power supply) or SAE J1939-13 (12 or 24 VDC power supply).

4.7.3.2. (reserved for TCP/IP (Ethernet) based wired communication.)

4.7.3.3. Connector location

The connector shall be located in the driver's side foot-well region of the vehicle interior in the area bound by the driver's side of the vehicle and the driver's side edge of the centre console (or the vehicle centreline if the vehicle does not have a centre console) and at a location no higher than the bottom of the steering wheel when in the lowest adjustable position. The connector may not be located on or in the centre console (i.e. neither on the horizontal faces near the floor-mounted gear selector, parking brake lever, or cup holders nor on the vertical faces near the stereo/radio, climate system, or navigation system controls). The location of the connector shall be capable of being easily identified and accessed (e.g. to connect an off-board tool). For vehicles equipped with a driver's side door, the connector shall be capable of being easily identified and accessed by someone standing (or "crouched") outside the driver's side of the vehicle with the driver's side door open.

The administrative department may approve upon request of the manufacturer an alternative location provided the installation position shall be easily accessible and protected from accidental damage during normal conditions of use, e.g. the location as described in ISO 15031 series of standards.

If the connector is covered or located in a specific equipment box, the cover or the compartment door must be removable by hand without the use of any tools and be clearly labelled "OBD" to identify the location of the connector.

The manufacturer may equip vehicles with additional diagnostic connectors and data-links for manufacturer-specific purposes other than the required OBD functions. If the additional connector conforms to one of the standard diagnostic connectors allowed in

appendix 6, only the connector required by this annex shall be clearly labelled "OBD" to distinguish it from other similar connectors.

4.7.4. Erasing / resetting OBD information by a scan-tool

On request of the scan tool, the following data shall be erased or reset to the value specified in this annex from the computer memory.

OBD information data	Erasable	Resetable 8/
malfunction indicator status		X
readiness of the OBD system		X
number of engine operating hours since the malfunction indicator has been activated (continuous MI counter)	X	
all DTCs	X	
the value of the B1 counter with the highest number of engine operating hours		X
the number of engine operating hours from the B1-counter(s)		X
the freeze frame data requested by this annex	X	

OBD information shall not be erased by disconnection of the vehicle's battery(s).

4.8. Electronic security

Any vehicle with an emission control unit must include features to deter modification, except as authorized by the manufacturer. The manufacturer shall authorize modifications if these modifications are necessary for the diagnosis, servicing, inspection, retrofitting or repair of the vehicle.

Any reprogramable computer codes or operating parameters shall be resistant to tampering and afford a level of protection at least as good as the provisions in ISO 15031-7 (SAE J2186) or J1939-73 provided that the security exchange is conducted using the protocols and diagnostic connector as prescribed in this annex. Any removable calibration memory chips shall be potted, encased in a sealed container or protected by electronic algorithms and shall not be changeable without the use of specialised tools and procedures.

Computer-coded engine operating parameters shall not be changeable without the use of specialised tools and procedures (e.g. soldered or potted computer components or sealed (or soldered) computer enclosures).

Manufacturers shall take adequate steps to protect the maximum fuel delivery setting from tampering while a vehicle is in-service.

Manufacturers may apply to the administrative department for an exemption from one of

8/ to the value specified in the appropriate section of this annex

these requirements for those vehicles that are unlikely to require protection. The criteria that the administrative department will evaluate in considering an exemption will include, but are not limited to, the current availability of performance chips, the high-performance capability of the vehicle and the projected sales volume of the vehicle.

Manufacturers using programmable computer code systems (e.g. electrical erasable programmable read-only memory, EEPROM) shall deter unauthorized reprogramming. Manufacturers shall include enhanced tamper-protection strategies and write protect features requiring electronic access to an off-site computer maintained by the manufacturer. Alternative methods giving an equivalent level of tamper protection may be approved by the administrative department

4.9. Durability of the OBD system

The OBD system shall be designed and constructed so as to enable it to identify types of malfunctions over the complete life of the vehicle or engine system.

Any additional provisions addressing the durability of OBD systems are contained in this annex.

An OBD system shall not be programmed or otherwise designed to partially or totally deactivate based on age and/or mileage of the vehicle during the actual life of the vehicle, nor shall the system contain any algorithm or strategy designed to reduce the effectiveness of the OBD system over time.

5. PERFORMANCE REQUIREMENTS

5.1. Thresholds

The OTLs for the applicable monitoring criteria defined in appendix 3 are defined in the main part of this Regulation

5.2. Temporary disablement of the OBD system

Approval authorities may approve that an OBD system be temporarily disabled under the conditions specified in the following sub-paragraphs.

At the time of approval or type-approval, the manufacturer shall provide the administrative department with the detailed description of each of the OBD system's temporary disablement strategies and the data and/or engineering evaluation demonstrating that monitoring during the applicable conditions would be unreliable or impractical.

In all cases, monitoring shall resume once the conditions justifying temporary disablement are no longer present.

5.2.1. Engine/vehicle operational safety

Manufacturers may request approval to disable the affected OBD monitoring systems when operational safety strategies are activated.

The OBD monitoring system is not required to evaluate components during malfunction if such evaluation would result in a risk to the safe use of the vehicle.

5.2.2. Ambient temperature and altitude conditions

Manufacturers may request approval to disable OBD system monitors at ambient engine start temperatures below 266 K (-7 degrees Celsius or 20 degrees Fahrenheit) or above 308 K (35 degrees Celsius or 95 degrees Fahrenheit), or at elevations above 2,500 meters (8,202 feet) above sea level.

A manufacturer may further request approval that an OBD system monitor be disabled at other ambient engine start temperatures upon determining that the manufacturer has demonstrated with data and/or an engineering evaluation that misdiagnosis would occur at the ambient temperatures because of its effect on the component itself (e.g. component freezing).

Note: Ambient conditions may be estimated by indirect methods. For example ambient temperature conditions may be determined based on intake air temperature.

5.2.3. Low fuel level

Manufacturers may request approval to disable monitoring systems that are affected by low fuel level or running out of fuel (e.g. diagnosis of a malfunction of the fuelling system or misfiring). The low fuel level considered for such a disablement shall not exceed 100 litres or 20 per cent of the nominal capacity of the fuel tank, whichever is lower.

5.2.4. Vehicle battery or system voltage levels

Manufacturers may request approval to disable monitoring systems that can be affected by vehicle battery or system voltage levels.

5.2.4.1. Low voltage

For monitoring systems affected by low vehicle battery or system voltages, manufacturers may request approval to disable monitoring systems when the battery or system voltage is below 90 per cent of the nominal voltage (or 11.0 Volts for a 12 Volt battery, 22.0 Volts for a 24 volt battery). Manufacturers may request approval to utilize a voltage threshold higher than this value to disable system monitoring.

The manufacturer shall demonstrate that monitoring at the voltages would be unreliable and that either operation of a vehicle below the disablement criteria for extended periods of time is unlikely or the OBD system monitors the battery or system voltage

and will detect a malfunction at the voltage used to disable other monitors.

5.2.4.2. High voltage

For emission related monitoring systems affected by high vehicle battery or system voltages, manufacturers may request approval to disable monitoring systems when the battery or system voltage exceeds a manufacturer-defined voltage.

The manufacturer shall demonstrate that monitoring above the manufacturer-defined voltage would be unreliable and that either the electrical charging system/alternator warning light is illuminated (or voltage gauge is in the "red zone") or the OBD system monitors the battery or system voltage and will detect a malfunction at the voltage used to disable other monitors.

5.2.5. Active PTO (power take-off units)

The manufacturer may request approval to temporarily disable affected monitoring systems in vehicles equipped with a PTO unit, under the condition where that PTO unit is temporarily active.

5.2.6. Forced regeneration

The manufacturer may request approval to disable the affected OBD monitoring systems during the forced regeneration of an emission control system downstream of the engine (e.g. a particulate filter).

5.2.7. AECS

The manufacturer may request approval to disable OBD system monitors during the operation of an AECS, including MECS, under conditions not already covered in paragraph 5.2. if the monitoring capability of a monitor is affected by the operation of an AECS.

6. DEMONSTRATION REQUIREMENTS

The basic elements for demonstrating the compliance of an OBD system with the requirements of this annex are as follows:

(a) procedure for selecting the OBD-parent engine system. The OBD-parent engine system is selected by the manufacturer in agreement with the administrative department.

(b) procedure for demonstrating the classification of a malfunction. The manufacturer submits to the administrative department the classification of each malfunction for that OBD-parent engine system and the necessary supporting data in order to justify each classification.

(c) procedure for qualifying a deteriorated component. The manufacturer shall provide, on request of the administrative department, deteriorated components for OBD testing purposes. These components are qualified on the basis of supporting

data provided by the manufacturer.

6.1. Emission-OBD family

The manufacturer is responsible for determining the composition of an emission-OBD family. Grouping engine systems within an emission-OBD family shall be based on good engineering judgement and be subject to approval by the administrative department.

Engines that do not belong to the same engine family may still belong to the same emission-OBD family.

6.1.1. Parameters defining an emission-OBD family

An emission-OBD family is characterised by basic design parameters that shall be common to engine systems within the family.

In order that engine systems are considered to belong to the same OBD-engine family, the following list of basic parameters shall be similar:

(a) mission control systems
(b) methods of OBD monitoring
(c) criteria for performance and component monitoring
(d) monitoring parameters (e.g. frequency)

These similarities shall be demonstrated by the manufacturer by means of relevant engineering demonstration or other appropriate procedures and subject to the approval of the administrative department.

The manufacturer may request approval by the administrative department of minor differences in the methods of monitoring/diagnosing the engine emission control system due to engine system configuration variation, when these methods are considered similar by the manufacturer and:

(a) they differ only to match specificities of the considered components (e.g. size, exhaust flow, etc.); or
(b) their similarities are based on good engineering judgement.

6.1.2. OBD-parent engine system

Compliance of an emission-OBD family with the requirements of this annex is achieved by demonstrating the compliance of the OBD-parent engine system of this family.

The selection of the OBD-parent engine system is made by the manufacturer and subject to the approval of the administrative department.

Prior to testing the administrative department may decide to request the manufacturer to select an additional engine for demonstration.

The manufacturer may also propose to the administrative department to test additional engines to cover the complete emission-OBD family.

6.2. Procedures for demonstrating the malfunction classification

The manufacturer shall provide the documentation justifying the proper classification of each malfunction to the administrative department. This documentation shall include a failure analysis (for example elements of a "failure mode and effect analysis") and may also include:

(a) simulation results
(b) test results
(c) reference to previously approved classification

In the following paragraphs the requirements for demonstrating the correct classification are listed, including requirements for testing. The minimum number of tests is four and the maximum number of tests is four times the number of engine families considered within the emission OBD family. The administrative department may decide to curtail the test at any time before this maximum number of failure tests has been reached.

In specific cases where the classification testing is not possible (for example, if an MECS is activated and the engine cannot run the applicable test, etc.), the malfunction may be classified based on technical justification. This exception shall be documented by the manufacturer and is subject to the agreement of the administrative department.

6.2.1. Demonstration of classification into A

The classification by the manufacturer of a malfunction into Class A shall not be subject to a demonstration test.

If the administrative department disagrees with a manufacturer's classification of a malfunction as Class A, the administrative department requires the classification of the malfunction into Class B1, B2 or C, as appropriate.

In that case the approval document shall record that the malfunction classification has been assigned according to the request of the administrative department.

6.2.2. Demonstration of classification into B1 (distinguishing between A and B1)

In order to justify the classification of a malfunction into Class B1 the documentation shall clearly demonstrate that, in some circumstances 9/, the malfunction results in emissions that are lower than the OTLs.

9/ Examples of circumstances that may influence if and when OTLs are exceeded are the age of the engine system or whether the test is conducted with a new or aged component.

In the case that the administrative department requires an emission test for demonstrating the classification of a malfunction into Class B1 the manufacturer shall demonstrate that the emissions due to that particular malfunction are, in selected circumstances, below the OTLs:

(a) the manufacturer selects the circumstances of the test in agreement with the administrative department;

(b) the manufacturer shall not be required to demonstrate that in other circumstances the emissions due to the malfunction are actually above the OTLs.

If the manufacturer fails to demonstrate the classification as Class B1, the malfunction is classified as Class A.

6.2.3. Demonstration of classification into B1 (distinguishing between B2 and B1)

If the administrative department disagrees with a manufacturer's classification of a malfunction as Class B1 because it considers that the OTLs are not exceeded, the administrative department requires the reclassification of that malfunction into Class B2 or C. In that case the approval documents shall record that the malfunction classification has been assigned according to the request of the administrative department.

6.2.4. Demonstration of classification into B2 (distinguishing between B2 and B1)

In order to justify the classification of a malfunction into Class B2 the manufacturer shall demonstrate that emissions are lower than the OTLs.

In case the administrative department disagrees with the classification of a malfunction as Class B2 because it considers that the OTLs are exceeded, the manufacturer may be required to demonstrate by testing that the emissions due to the malfunction are below the OTLs. If the test fails, then the administrative department shall require the reclassification of that malfunction into A or B1 and the manufacturer shall subsequently demonstrate the appropriate classification and the documentation shall be updated.

6.2.5. Demonstration of classification into B2 (distinguishing between B2 and C)

If the administrative department disagrees with a manufacturer's classification of a malfunction as Class B2 because it considers the regulated emission limits are not exceeded, the administrative department requires the reclassification of that malfunction into Class C. In that case the approval documents shall record that the malfunction classification has been assigned according to the request of the administrative department.

6.2.6. Demonstration of classification into C

In order to justify the classification of a malfunction into Class C the manufacturer shall demonstrate that emissions are lower than the regulated emission limits.

In case the administrative department disagrees with the classification of a malfunction as Class C the manufacturer may be required to demonstrate by testing that the emissions due to the malfunction are below the regulated emission limits.

If the test fails, then the administrative department shall request the reclassification of that malfunction and the manufacturer shall subsequently demonstrate the appropriate reclassification and the documentation shall be updated.

6.3. Procedures for demonstrating the OBD performance

The manufacturer shall submit to the administrative department a complete documentation package justifying the compliance of the OBD system as regards its monitoring capability, which may include:

(a) algorithms and decision charts
(b) tests and/or simulation results
(c) reference to previously approved monitoring systems, etc.

In the following paragraphs the requirements for demonstrating the OBD performance are listed, including requirements for testing. The minimum number of tests is four and the maximum number of tests is four times the number of engine families considered within the emission OBD family. The administrative department may decide to curtail the test at any time before this maximum number of failure tests has been reached.

6.3.1. Procedures for demonstrating the OBD performance by testing

In addition to the supporting data referred to in paragraph 6.3., the manufacturer shall demonstrate the proper monitoring of specific emission control systems or components by testing them on an engine test-bed according to the test procedures specified in paragraph 7.2. of this annex.

In that case, the manufacturer shall make available the qualified deteriorated components or the electrical device which would be used to simulate a malfunction.

The proper detection of the malfunction by the OBD system and its proper response to that detection (cf. MI indication, DTC storage, etc.) shall be demonstrated according to paragraph 7.2.

6.3.2. Procedures for qualifying a deteriorated component (or system)

This paragraph applies to the cases where the malfunction selected for an OBD demonstration test is monitored against tailpipe emissions 10/ (emission threshold monitoring - see paragraph 4.2.), by an emission test, the qualification of that deteriorated component.

10/ This paragraph will be extended to other monitors than mission threshold monitors at a later stage.

In very specific cases the qualification of deteriorated components or systems by testing may not be possible (for example, if an MECS is activated and the engine cannot run the applicable test, etc.). In such cases, the deteriorated component shall be qualified without testing. This exception shall be documented by the manufacturer and is subject to the agreement of the administrative department.

6.3.2.1. Procedure for qualifying a deteriorated component used to demonstrate the detection of classes A and B1 malfunctions

In the case the malfunction selected by the administrative department results in tailpipe emissions that may exceed an OBD threshold limit, the manufacturer shall demonstrate by an emission test according to paragraph 7. that the deteriorated component or device does not result in the relevant emission exceeding its OTL by more than 20 per cent.

6.3.2.2. Qualification of deteriorated components used to demonstrate the detection of Class B2 malfunctions

In the case of Class B2 malfunctions, and upon request of the administrative department, the manufacturer shall demonstrate by an emission test according to paragraph 7. that the deteriorated component or device does not lead the relevant emission to exceed its applicable OTL.

6.3.2.3. Qualification of deteriorated components used to demonstrate the detection of Class C malfunctions

In the case of Class C malfunctions, and upon request of the administrative department, the manufacturer shall demonstrate by an emission test according to paragraph 7. that the deteriorated component or device does not lead the relevant emission to exceed its applicable regulated emission limit.

6.3.3. Test report

The test report shall contain, at a minimum, the information set out in appendix 4.

6.4. Approval of an OBD system containing deficiencies

6.4.1. Approval authorities may approve upon request of a manufacturer an OBD system even though the system contains one or more deficiencies.

In considering the request, the administrative department shall determine whether compliance with the requirements of this annex is feasible or unreasonable.

The administrative department 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 annex and that the manufacturer has demonstrated an acceptable level of effort toward meeting the requirements of the annex.

The administrative department will not accept any deficiency request that includes the complete lack of a required diagnostic monitor (i.e. a complete lack of the monitors required in appendix 3).

6.4.2. Deficiency period

A deficiency is granted for a period of one year after the date of approval of the engine system.

If the manufacturer can adequately demonstrate to the administrative department that substantial engine modifications and additional lead time would be necessary to correct the deficiency, then this deficiency can be granted again for an additional one year, provided that the total deficiency period does not exceed 3 years (i.e. 3 times one year deficiency allowance is permitted).

The manufacturer cannot apply for a renewal of the deficiency period.

7. TEST PROCEDURES

7.1. Testing process

The demonstration by testing of the proper malfunction classification and the demonstration by testing of the proper monitoring performance of an OBD system are issues that shall be considered separately during the testing process. For example, a Class A malfunction will not require a classification test while it may be subject to an OBD performance test.

Where appropriate, the same test may be used to demonstrate the correct classification of a malfunction, the qualification of a deteriorated component provided by the manufacturer and the correct monitoring by the OBD system.

The engine system on which the OBD system is tested shall comply with the emission requirements of this Regulation.

7.1.1. Testing process for demonstrating the malfunction classification

When, according to paragraph 6.2., the administrative department requests the manufacturer to justify by testing the classification of a specific malfunction, the compliance demonstration will consist of a series of emission tests.

According to paragraph 6.2.2., when testing is required by the administrative department to justify the classification of a malfunction into Class B1 rather than in Class A, the manufacturer shall demonstrate that the emissions due to that particular

malfunction are, in selected circumstances, below the OTLs:

(a) the manufacturer selects these circumstances of test in agreement with the administrative department

(b) the manufacturer shall not be required to demonstrate that in other circumstances the emissions due to the malfunction are actually above the OTLs.

The emission test may be repeated upon request of the manufacturer up to three times.

If any of these tests leads to emissions below the considered OTL, then the malfunction classification into Class B1 shall be approved.

When testing is required by the administrative department to justify the classification of a malfunction into Class B2 rather than in Class B1 or into Class C rather than in Class B2, the emission test shall not be repeated. If the emissions measured in the test are above the OTL or the emission limit, respectively, then the malfunction shall require a reclassification.

Note: According to paragraph 6.2.1., this paragraph does not apply to malfunctions classified into Class A.

7.1.2. Testing process for demonstrating the OBD performance

When the administrative department requests according to paragraph 6.3. to test the OBD system performance, the compliance demonstration shall consist of the following phases:

(a) a malfunction is selected by the administrative department and a corresponding deteriorated component or system shall be made available by the manufacturer;

(b) when appropriate and if requested, the manufacturer shall demonstrate by an emission test that the deteriorated component is qualified for a monitoring demonstration;

(c) the manufacturer shall demonstrate that the OBD system responds in a manner that complies with the provisions of this annex (i.e. MI indication, DTC storage, etc.) at the latest by the end of a series of OBD test-cycles.

7.1.2.1. Qualification of the deteriorated component

When the administrative department requests the manufacturer to qualify a deteriorated component by testing according to paragraph 6.3.2., this demonstration shall be made by performing an emissions test.

If it is determined that the installation of a deteriorated component or device on an engine system means that a comparison with the OBD threshold limits is not possible (e.g. because the statistical conditions for validating the applicable emission test cycle are not met), the malfunction of that component or device may be considered as qualified upon the agreement of the administrative department based on technical rationale provided by the manufacturer.

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 be attained during the test, the deteriorated component or device may be considered as qualified upon the agreement of the administrative department based on technical rationale provided by the manufacturer.

7.1.2.2. Malfunction detection

Each monitor selected by the administrative department to be tested on an engine test-bed, shall respond to the introduction of a qualified deteriorated component in a manner that meets the requirements of this annex within two consecutive OBD test-cycles according to paragraph 7.2.2. of this annex.

When it has been specified in the monitoring description and agreed by the administrative department that a specific monitor needs more than two operating sequences to complete its monitoring, the number of OBD test-cycles may be increased according to the manufacturer's request.

Each individual OBD test-cycle in the demonstration test shall be separated by an engine shut-off. The time until the next start-up shall take into consideration any monitoring that may occur after engine shut-off and any necessary condition that must exist for monitoring to occur at the next start up.

The test is considered complete as soon as the OBD system has responded in a manner that meets the requirements of this annex.

7.2. Applicable tests

The emission test is the test-cycle used for the measurement of the regulated emissions.

The OBD test-cycle is the test-cycle used when evaluating the performance of the OBD monitor. In many cases these test-cycles are the same.

7.2.1. Emission test cycle

The test-cycle considered in this annex for measuring emissions is the WHTC test-cycle as described in Annex 10.

7.2.2. OBD test cycle

The World-wide harmonized OBD test-cycle considered in this annex is the hot part of the WHTC cycle as described in Annex 10.

On request of the manufacturer and with approval of the administrative department, the cold part of the WHTC cycle can be used as an alternative OBD test-cycle. The request shall contain elements (technical considerations, simulation, test results, etc.) demonstrating:

(a) the requested test-cycle results in a monitor that will run in real world driving, and;
(b) the applicable world-wide harmonized or regionally accepted OBD test-cycle is shown to be less appropriate for the considered monitoring (e.g. fluid consumption monitoring).

7.2.3. Test operating conditions

The conditions (i.e. temperature, altitude, fuel quality etc.) for conducting the tests referred to in paragraphs 7.2.1. and 7.2.2. shall be those required for operating the WHTC test cycle as described in Annex 10.

In the case of an emission test aimed at justifying the classification of a specific malfunction into Class B1, the test operating conditions may, per decision of the manufacturer, deviate from the ones in the paragraphs above according to paragraph 6.2.2.

7.3. Test reports

The test report shall contain, at a minimum, the information set out in appendix 4.

8. DOCUMENTATION REQUIREMENTS

8.1. Documentation for purpose of approval

The manufacturer shall provide a documentation package that includes a full description of the OBD system. The documentation package shall be made available in two parts:

(a) a first part, which may be brief, provided that it exhibits evidence concerning the relationships between monitors, sensors/actuators, and operating conditions (i.e. describes all enable conditions for monitors to run and disable conditions that cause monitors not to run). The documentation shall describe the functional operation of the OBD, including the malfunction ranking within the hierarchical classification. This material shall be retained by the administrative department. This information may be made available to interested parties upon request.
(b) a second part containing any data, including details of qualified deteriorated components or systems and associated test results, which are used as evidence to support the decision process referred to above, and a listing of all input and output signals that are available to the engine system and monitored by the OBD system. This second part shall also outline each monitoring strategy and the decision process.

This second part shall remain strictly confidential. It may be kept by the administrative department, or, at the discretion of the administrative department, may be retained by the manufacturer but shall be made open for inspection by the administrative department at the time of approval or at any time during the validity of the approval.

8.1.1. Documentation associated with each monitored component or system

The documentation package included in the second part shall contain but shall not be limited to the following information for each monitored component or system:

(a) the malfunctions and associated DTC(s);
(b) the monitoring method used for malfunction detection;
(c) the parameters used and the conditions necessary for malfunction detection and when applicable the fault criteria limits (performance and component monitoring);
(d) the criteria for storing a DTC;
(e) the monitoring "time length" (i.e. the operation time/procedure necessary to complete the monitoring) and the monitoring "frequency" (e.g. continuous, once per trip, etc.).

8.1.2. Documentation associated with the malfunction classification

The documentation package included in the second part shall contain but shall not be limited to the following information for malfunction classification:

The malfunction classification of each DTC shall be documented. This classification may be different for different engine types (e.g. different engine ratings) within the same emission-OBD family.

This information shall include the technical justification required in paragraph 4.2. of this annex for classification into Class A, Class B1 or Class B2.

8.1.3. Documentation associated with the emission-OBD family

The documentation package included in the second part shall contain but shall not be limited to the following information for emission OBD-family:

A description of the emission-OBD family shall be provided. This description shall include a list and a description of the engine types within the family, the description of the OBD-parent engine system, and all elements that characterise the family according to paragraph 6.1.1. of this annex.

In the case where the emission-OBD family includes engines belonging to different engine families, a summary description of these engine families shall be provided.

In addition, the manufacturer shall provide a list of all electronic input and output an identification of the communication protocol utilized by each emission-OBD family.

8.2. Documentation for installing in a vehicle an OBD equipped engine system

The engine manufacturer shall include in the installation documents of its engine system the appropriate requirements that will ensure the vehicle, when used on the road or elsewhere as appropriate, will comply with the requirements of this annex. This

documentation shall include but is not limited to:

(a) the detailed technical requirements, including the provisions ensuring the compatibility with the OBD system of the engine system;

(b) the verification procedure to be completed.

The existence and the adequacy of such installation requirements may be checked during the approval process of the engine system.

Note: In the case a vehicle manufacturer applies for a direct approval of the installation of the OBD system on the vehicle, this documentation is not required.

8.3. Documentation regarding OBD related information

Requirements of appendix 7 have to be fulfilled.

9. APPENDICES

Appendix 1: Approval of installation of OBD systems

Appendix 2: Malfunctions - Illustration of the DTC status - illustration of the MI and counters activation schemes

Appendix 3: Monitoring Requirements

Appendix 4: Technical compliance REPORT

Appendix 5: Freeze frame and data stream information

Appendix 6: Reference Standard Documents

Appendix 7: Documentation regarding OBD related information

Annex 11 - Appendix 1

APPROVAL OF INSTALLATION OF OBD SYSTEMS

This appendix considers the case where the vehicle manufacturer requests approval of the installation on a vehicle of (an) OBD system(s) within an emission OBD family, that is (are) certified to the requirements of this annex.

In this case, and in addition to the general requirements of this annex, a demonstration of the correct installation is required. This demonstration shall be done on the basis of the appropriate element of design, results of verification tests, etc. and address the conformity of the following elements to the requirements of this annex:

(a) the installation on-board the vehicle as regards its compatibility with the OBD system of the engine-system;
(b) the MI (pictogram, activation schemes, etc.);
(c) the wired communication interface.

Correct MI illumination, information storage and on-board off-board OBD communication will be checked. But any check shall not force dismounting the engine system (e.g. an electric disconnection may be selected).

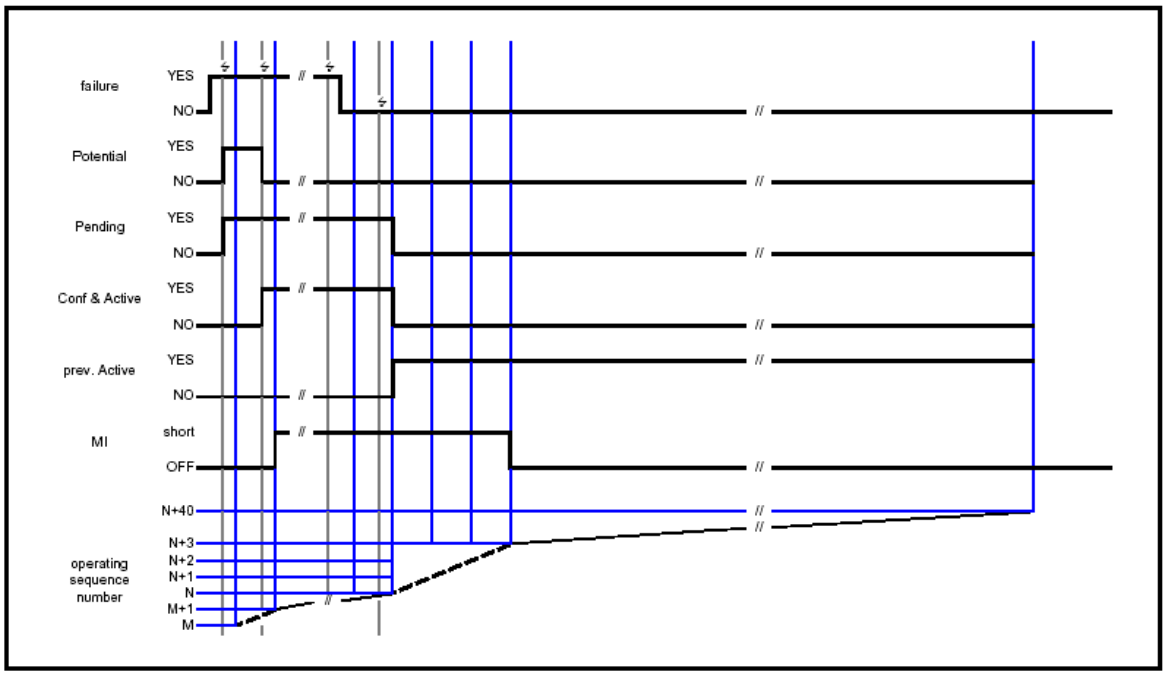
Annex 11 - Appendix 2

MALFUNCTIONS
ILLUSTRATION OF THE DTC STATUS
ILLUSTRATION OF THE MI AND COUNTERS ACTIVATION SCHEMES

This appendix aims at illustrating the requirements set in paragraphs 4.3. and 4.6.6. of this annex. It contains the following figures:

Figure 1: DTC status in case of a class B1 malfunction
Figure 2 DTC status in case of 2 consecutive different class B1 malfunctions
Figure 3: DTC status in case of the re-occurrence of a class B1 malfunction
Figure 4: Class A malfunction -activation of the MI and MI counters
figure 5: Class B1 malfunction - activation of the B1 counter in 5 use Cases.

Figure 1: DTC status in case of a class B1 malfunction



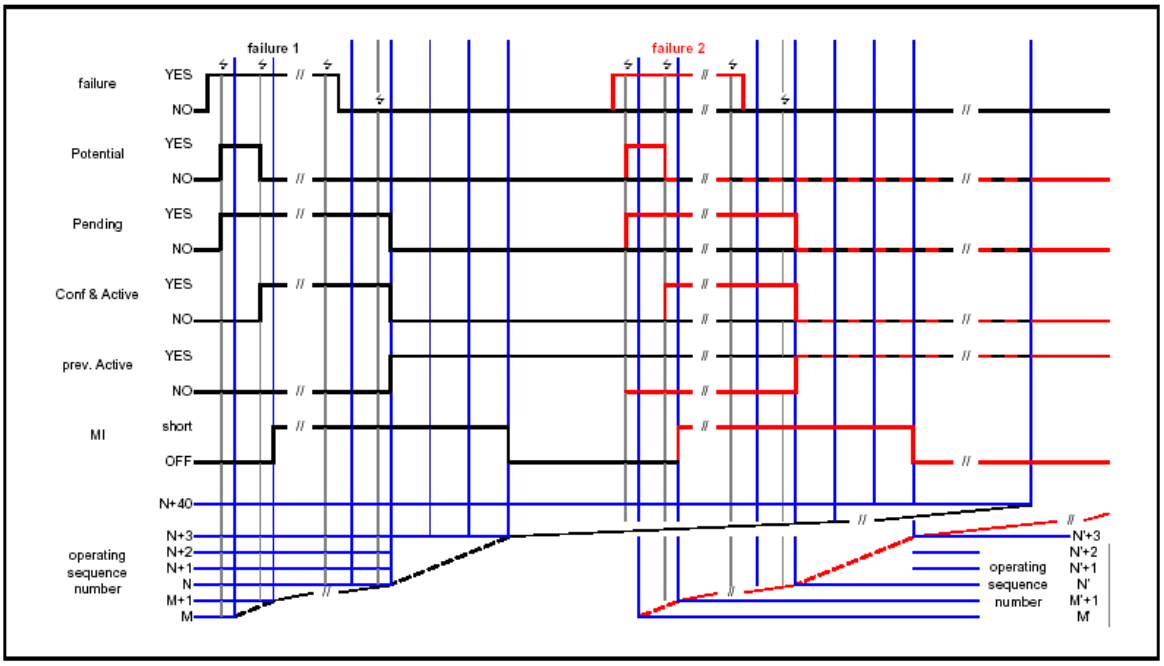
Notes:

ϟ means the point a monitoring of the concerned malfunction occurs

N, M The annex requires the identification of "key" operating sequences during which some events occurs, and the counting of the subsequent operating sequences. For the purpose of illustrating this requirement, the "key" operating sequences have been given the values N and M.

E.g. M means the first operating sequence following the detection of a potential malfunction, and N means the operating sequence during which the MI is switched OFF.

Figure 2: DTC status in case of 2 consecutive different class B1 malfunctions



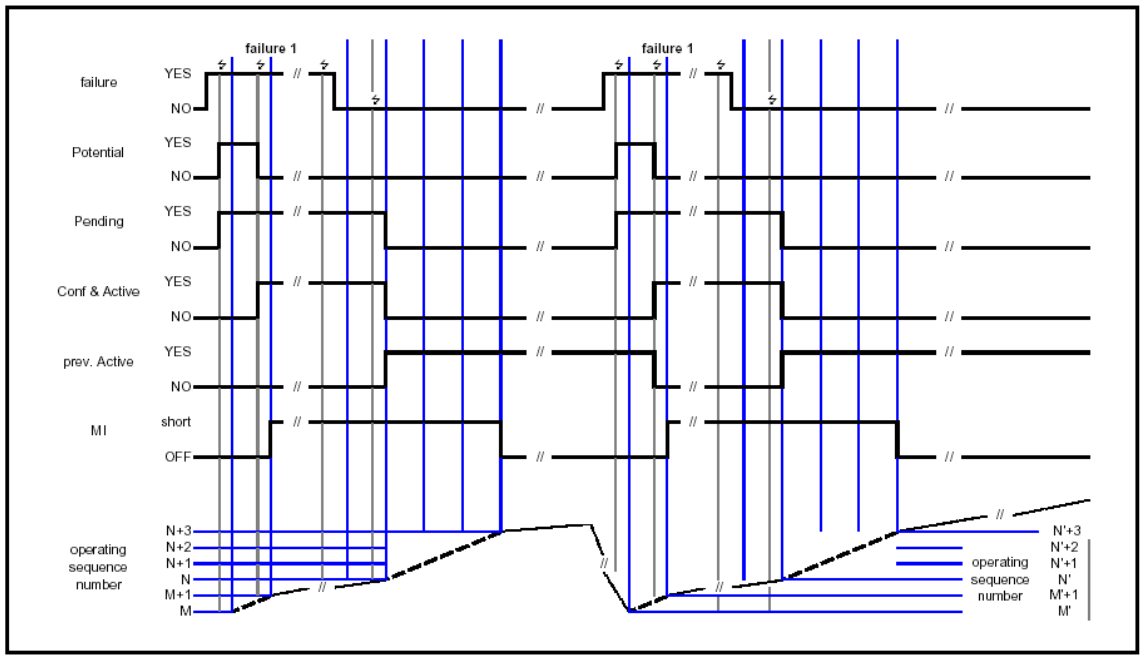
Notes:

↯ means the point a monitoring of the concerned malfunction occurs

N, M, N', M' The annex requires the identification of "key" operating sequences during which some events occurs, and the counting of the subsequent operating sequences. For the purpose of illustrating this requirement, the "key" operating sequences have been given the values N and M for the first malfunction, respectively N' and M' for the second one.
E.g. M means the first operating sequence following the detection of a potential malfunction, and N means the operating sequence during which the MI is switched OFF.

N + 40 the fortieth operating sequence after the first extinction of the MI or 200 engine operating hours, whichever the earliest.

Figure 3: DTC status in case of the re-occurrence of a class B1 malfunction



Notes:

ϟ means the point a monitoring of the concerned malfunction occurs

N, M, N', M' The annex requires the identification of "key" operating sequences during which some events occurs, and the counting of the subsequent operating sequences. For the purpose of illustrating this requirement, the "key" operating sequences have been given the values N and M for the first occurrence of a malfunction, respectively N' and M' for the second one. E.g. M means the first operating sequence following the detection of a potential malfunction, and N means the operating sequence during which the MI is switched OFF.

Figure 4: Class A malfunction - activation of the MI and MI counters

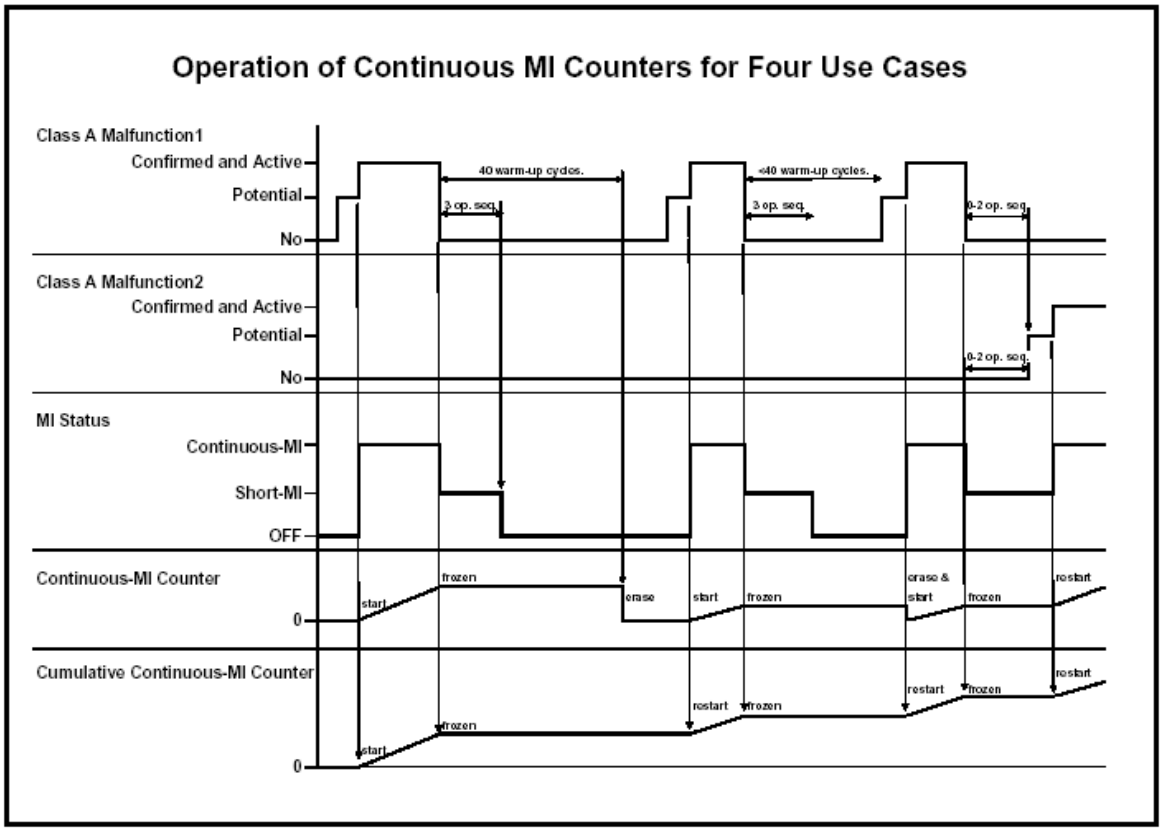
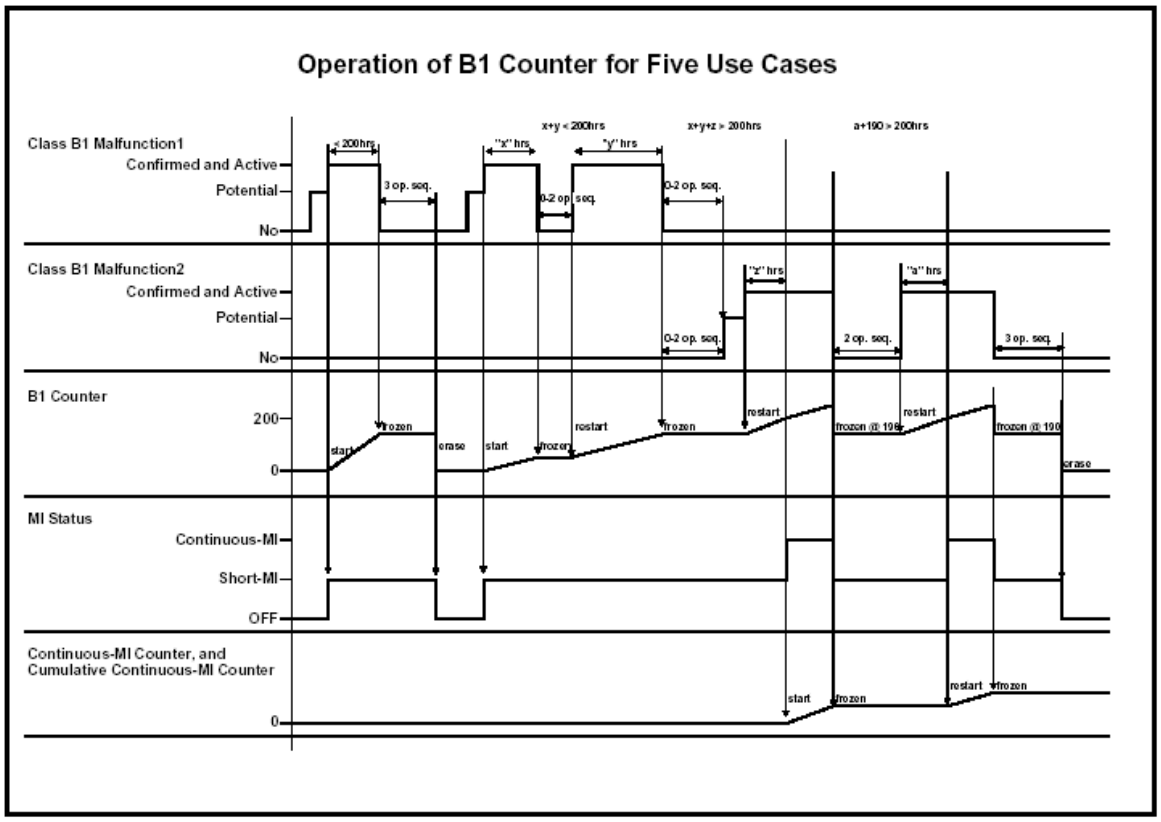


Figure 5: Class B1 malfunction - activation of the B1 counter in 5 use Cases.



Note: In this example, it is assumed that there is a single B1 counter.

Annex 11 - Appendix 3

MONITORING REQUIREMENTS

The Items of this appendix list the systems or components required to be monitored by the OBD system, according to paragraph 4.2.

Appendix 3 - Item 1

ELECTRIC / ELECTRONIC COMPONENTS MONITORING

Electric/electronic components used to control or monitor the emission control systems described in this appendix shall be subject to Component Monitoring according to the provisions of paragraph 4.1. of this annex. This includes, but is not limited to, pressure sensors, temperature sensors, exhaust gas sensors, in-exhaust fuel or reductant injector(s), in-exhaust burners or heating elements, glow plugs, intake air heaters.

Wherever a feedback control loop exists, the OBD system shall monitor the system's ability to maintain feedback control as designed (e.g. to enter feedback control within a manufacturer specified time interval, system fails to maintain feedback control, feedback control has used up all the adjustment allowed by the manufacturer) - component monitoring.

Appendix 3 - Item 2

DIESEL PARTICULATE FILTER (DPF), OR PARTICULATE MATTER TRAP

The OBD system shall monitor the following elements of the DPF system on engines so-equipped for proper operation:

(a) DPF substrate: the presence of the DPF substrate - total functional failure monitoring

(b) DPF performance: clogging of the DPF - total functional failure

(c) DPF performance: filtering and regeneration processes (e.g. particulate accumulation during the filtering process and particulate removal during a forced regeneration process) - performance monitoring (for example, evaluation of measurable DPF properties such as backpressure or differential pressure, which may not detect all failure modes that reduce trapping efficiency).

Appendix 3 - Item 3

SELECTIVE CATALYTIC REDUCTION (SCR) MONITORING

For the purpose of this Item, SCR means selective catalytic reduction or other lean NO_x catalyst device. The OBD system shall monitor the following elements of the SCR system on engines so-equipped for proper operation:

(a) active/intrusive reductant injection system: the system's ability to regulate reductant delivery properly, whether delivered via an in-exhaust injection or an in-cylinder injection - performance monitoring.

(b) active/intrusive reductant: the on-board availability of the reductant, the proper consumption of the reductant if a reductant other than fuel is used (e.g. urea) - performance monitoring.

(c) active/intrusive reductant: to the extent feasible the quality of the reductant if a reductant other than fuel is used (e.g. urea) - performance monitoring.

Appendix 3 - Item 4

LEAN-NOX TRAP (LNT, OR NOX ADSORBER)

The OBD system shall monitor the following elements of the LNT system on engines so-equipped for proper operation:

(a) LNT capability: the LNT system's ability to adsorb/store and convert NO_x - performance monitoring.

(b) LNT active/intrusive reductant injection system: the system's ability to regulate reductant delivery properly, whether delivered via an in-exhaust injection or an in-cylinder injection - performance monitoring.

Appendix 3 - Item 5

DIESEL OXIDATION CATALYST (DOC) MONITORING

This Item applies to DOC that are separate from other after-treatment systems. Those that are included in the canning of an after-treatment system are covered within the appropriate Item of this appendix.

The OBD system shall monitor the following elements of the DOC on engines so-equipped for proper operation:

(a) HC conversion efficiency: the DOC's ability to convert HC upstream of other after-treatment devices - total functional failure monitoring.

(b) HC conversion efficiency: the DOC's ability to convert HC downstream of other after-treatment devices - total functional failure monitoring.

Appendix 3 - Item 6

EXHAUST GAS RECIRCULATION (EGR) SYSTEM MONITORING

The OBD system shall monitor the following elements of the EGR system on engines so-equipped for proper operation:

(a) EGR low/high flow: the EGR system's ability to maintain the commanded EGR flow rate, detecting both "flow rate too low" and "flow rate too high" conditions - emission threshold monitoring.

(b) slow response of the EGR actuator: the EGR system's ability to achieve the commanded flow rate within a manufacturer specified time interval following the command - performance monitoring.

(c) EGR cooler undercooling performance: the EGR cooler system's ability to achieve the manufacturer's specified cooling performance - performance monitoring

Appendix 3 - Item 7

FUEL SYSTEM MONITORING

The OBD system shall monitor the following elements of the Fuel system on engines so-equipped for proper operation:

(a) Fuel system pressure control: fuel system ability to achieve the commanded fuel pressure in closed loop control - performance monitoring.

(b) Fuel system pressure control: fuel system ability to achieve the commanded fuel pressure in closed loop control in the case where the system is so constructed that the pressure can be controlled independently of other parameters - performance monitoring.

(c) Fuel injection timing: fuel system ability to achieve the commanded fuel timing for at least one of the injection events when the engine is equipped with the appropriate sensors - performance monitoring.

Appendix 3 - Item 8

AIR HANDLING AND TURBOCHARGER/BOOST PRESSURE CONTROL SYSTEM

The OBD system shall monitor the following elements of the Air Handling and Turbocharger/Boost Pressure Control System system on engines so-equipped for proper operation:

(a) Turbo under/over boost: turbo boost system's ability to maintain the commanded boost pressure, detecting both "boost pressure too low" and "boost pressure too high" conditions - emission threshold monitoring.

(b) Variable geometry turbo (VGT) slow response: VGT system's ability to achieve the commanded geometry within a manufacturer specified time -performance monitoring.

(c) Charge air cooling: Charge air cooling system efficiency - total functional failure.

Appendix 3 - Item 9

VARIABLE VALVE TIMING (VVT) SYSTEM

The OBD system shall monitor the following elements of the Variable Valve Timing (VVT) System on engines so-equipped for proper operation:

(a) VVT target error: VVT system's ability to achieve the commanded valve timing - performance monitoring.

(b) VVT slow response: VVT system's ability to achieve the commanded valve timing within a manufacturer specified time interval following the command-performance monitoring.

Appendix 3 - Item 10

MISFIRE MONITORING

No prescriptions.

Appendix 3 - Item 11

CRANKCASE VENTILATION SYSTEM MONITORING

No prescriptions.

Annex 11 - Appendix 3 - Item 12

ENGINE COOLING SYSTEM MONITORING

The OBD system shall monitor the following elements of the Engine cooling system for proper operation:

(a) Engine coolant temperature (thermostat): Stuck open thermostat Manufacturers need not monitor the thermostat if its failure will not disable any other OBD monitors - total functional failure.

Manufacturers need not monitor the engine coolant temperature or the engine coolant temperature sensor if the engine coolant temperature or the engine coolant temperature sensor is not used to enable closed-loop/feedback control of any emissions control systems and/or will not disable any other monitor.

Manufacturers may suspend or delay the monitor for the time to reach close loop enable temperature if the engine is subjected to conditions that could lead to false diagnosis (e.g. vehicle operation at idle for more than 50 to 75 per cent of the warm-up time).

Appendix 3 - Item 13

EXHAUST GAS SENSOR MONITORING

The OBD system shall monitor the electrical elements of the exhaust gas sensors on engines so-equipped for proper operation according to item 1 to this appendix.

Appendix 3 - Item 14

IDLE SPEED CONTROL SYSTEM MONITORING

The OBD system shall monitor the electrical elements of the idle speed control systems on engines so-equipped for proper operation according to item 1 to this appendix.

Annex 11 - Appendix 4

TECHNICAL COMPLIANCE REPORT

This report is issued by the administrative department, according to paragraphs 6.3.3. and 7.3., after examination of an OBD system or an emission OBD family when that system or family complies with the requirements of this appendix.

The exact reference (including its version number) of this appendix shall be included in this report. The exact reference (including its version number) to this Regulation shall be included.

This report contains a cover page indicating the final compliance of the OBD system or emission OBD family and the following 5 items:

Item 1 INFORMATION CONCERNING THE OBD SYSTEM
Item 2 INFORMATION CONCERNING THE CONFORMITY OF THE OBD SYSTEM
Item 3 INFORMATION CONCERNING DEFICIENCIES
Item 4 INFORMATION CONCERNING DEMONSTRATION TESTS OF THE OBD SYSTEM
Item 5 TEST PROTOCOL

The content of the technical report, including its Items, shall, at a minimum, include the elements given in the following examples.

This report shall state that reproduction or publication in extracts of this report is not permitted without the written consent of the undersigned administrative department.

FINAL COMPLIANCE REPORT

The documentation package and the herewith described OBD system / emission OBD family comply with the requirements of the following regulation:

Regulation … / version …/ enforcement date ….

gtr …/ A + B / version …/ date ….

The technical compliance report encompasses … pages.

Place, date: . . . . . .

Author (name and signature)
Administrative department (name, stamp)

Item 1 to the technical compliance report (example)

INFORMATION CONCERNING THE OBD SYSTEM

1. Type of requested approval

Requested Approval	
- Approval of an individual OBD system	YES / NO
- Approval of an emission OBD family	YES / NO
- Approval of an OBD system as member of a certified emission OBD family	YES / NO
- Extension to include a new engine system into an emission OBD family	YES / NO
- Extension to address a design change that affects the OBD system	YES / NO
- Extension to address a malfunction reclassification	YES / NO

2. Information concerning the OBD system

Approval of an individual OBD system	
- type(s) 11/ of the engine system family (where applicable, see paragraph 6.1. of this annex), or type(s) 11/ of the single engine system(s)	. . . .
- OBD description (issued by the manufacturer): reference and date	
Approval of an emission OBD family	
- List of the engine families concerned by the emission OBD family (when applicable, see paragraph 6.1.)	. . . .
- Type 11/ of the parent engine system within the emission OBD family	. . . .
- List of the engine types 11/ within the emission OBD family	. . . .
- OBD description (issued by the manufacturer): reference and date	. . . .
Approval of an OBD system as member of a certified emission OBD family	
- List of the engine families concerned by the emission OBD family (when applicable, see paragraph 6.1.)	
- Type 11/ of the parent engine system within the emission OBD family	. . . .
- List of the engine types 11/ within the emission OBD family	. . . .
- Name of the engine system family concerned by the new OBD system (when applicable)	. . . .
- Type 11/ of the engine system concerned by the new OBD system	. . . .
- Extended OBD description (issued by the manufacturer): reference and date	. . . .
	. . . .

11/ as reported in the approval document

Extension to include a new engine system into an emission OBD family	
- List (extended if necessary) of the engine families concerned by the emission OBD family (when applicable, see paragraph 6.1.)	. . . .
- List (extended if necessary) of the engine types 11/ within the emission OBD family	. . . .
- Actualised (new or unchanged) type11/ of the parent engine system within the emission OBD family	. . . .
- Extended OBD description (issued by the manufacturer): reference and date	. . . .
Extension to address a design change that affects the OBD system	
- List of the engine families (when applicable) concerned by the design change	. . . .
- List of the engine types 11/ concerned by the design change	. . . .
- Actualised (when applicable, new or unchanged) type 11/ of the parent engine system within the emission OBD family	. . . .
- Modified OBD description (issued by the manufacturer): reference and date	. . . .
Extension to address a malfunction reclassification	
- List of the engine families (when applicable) concerned by the reclassification	. . . .
- List of the engine types 11/ concerned by the reclassification	. . . .
- Modified OBD description (issued by the manufacturer): reference and date	. . . .

Item 2 to the technical compliance report (example)

INFORMATION CONCERNING THE CONFORMITY OF THE OBD SYSTEM

1. Documentation package

The elements provided by the manufacturer in the documentation package of the emission OBD family, is complete and complies with the requirements of paragraph 8. of this annex, on the following issues:	
- documentation associated with each monitored component or system	YES / NO
- documentation associated with each DTC	YES / NO
- documentation associated with the malfunction classification	YES / NO
- documentation associated with the emission OBD family	YES / NO
The documentation required in paragraph 8.2. of this annex for installing an OBD system in a vehicle has been provided by the manufacturer in the documentation package, is complete, and complies with the requirements of this annex:	YES / NO
The installation of the engine system equipped with the OBD system complies with appendix 1 of this annex:	YES / NO

2. Content of the documentation

Monitoring The monitors comply with the requirements of paragraph 4.2. of this annex:	YES / NO
Classification The malfunction classification complies with the requirements of paragraph 4.5. of this annex:	YES / NO
MI activation scheme According to paragraph 4.6.3. of this annex, the MI-activation scheme is:	Discriminatory / Non-discriminatory
The activation and the extinguishing of the malfunction indicator comply with the requirements of paragraph 4.6. of this annex:	YES / NO
DTCs recording & erasing The recording and erasing of DTCs comply with the requirements of paragraphs 4.3. and 4.4. of this annex:	YES / NO

Disablement of the OBD system The strategies described in the documentation package for a momentary disconnection or disablement of the OBD system comply with the requirements of paragraph 5.2. of this annex	YES / NO
Electronic system security The measures described by the manufacturer for electronic system security comply with the requirements of paragraph 4.8. of this annex	YES / NO

Item 3 to the technical compliance report (example)

INFORMATION CONCERNING DEFICIENCIES

Number of deficiencies of OBD system	(ex: 4 deficiencies)
The deficiencies comply with the requirements of paragraph 6.4. of this annex	YES / NO
Deficiency No. 1 - Object of the deficiency - Period of the deficiency	 e.g. measuring of the Urea concentration (SCR) within defined tolerances e.g. one year / six months after the date of approval
(Description of deficiencies 2 to n-1)	
Deficiency No. n - Object of the deficiency - Period of the deficiency	 e.g. measuring of NH3 concentration behind SCR system e.g. one year / six months after the date of approval

Item 4 to the technical compliance report (example)

DEMONSTRATION TESTS OF THE OBD SYSTEM

1. Test result of the OBD system

Results of the tests The OBD system described in the above complying documentation package has been tested with success according to Paragraph 6 of this annex for demonstrating the compliance of monitors and of malfunction classifications as listed in item 5:	YES / NO

Details to the conducted demonstration tests are given in item 5.

1.1. OBD system tested on the engine test-bed

Engine - Engine name (manufacturer and commercial names): - Engine type (as reported in the approval document): - Engine number (serial number):	. . . .
Control units concerned by this annex (incl. engine ECUs) - Main functionality: - Identification number (software and calibration):	 . . . .
Diagnostic tool (scan tool used during testing) - Manufacturer: - Type: - Software / version	 . . . .
Test information - Ambient testing conditions (temperature, humidity, pressure): - Place of test (incl. altitude): - Testing fuel: - Engine lubricating oil: - Date of test:	 . . . .

2. Demonstration tests of the installation of the OBD system

In addition to the demonstration of the OBD system / emission OBD family, the installation of the OBD system / of the OBD systems within the emission OBD family has been tested on a vehicle, according to the provisions of appendix 1 of the referenced annex:	YES / NO

2.1. Test result of the installation of the OBD system

Results of the test If the installation of the OBD system has been tested on a vehicle, the installation of the OBD system has been tested with success according to appendix 1 to the referenced annex	YES / NO

2.2. Tested installation

If the installation of the OBD system has been tested on a vehicle:

Tested vehicle - Vehicle name (manufacturer and commercial names): - Vehicle type: - Vehicle Identification Number (VIN):	 . . . .
Diagnostic tool (scan tool used for testing) - Manufacturer: - Type: - Software / version:	 . . . .
Test information - Place and date:	 . . . .

Item 5 to the technical compliance report (example)
TEST PROTOCOL

OBD System Demonstration Test																		
- General -		- Demonstration of the Failure Classification -							- Demonstration of the OBD Performance -									
		- Test -		- Emission Level -			- Classification -		- Qualification of the Deteriorated Component -			- MI Activation -						
Failure Mode	Fault Code	Tested according to point	Test Cycle	above OTL	below OTL	below EL + X	Manufacturer proposed Classification	Final Classification (1)	Tested according to point	Test Cycle	qualified	Tested according to point	Test Cycle	Continuous-MI after ... cycle	short-MI after ... cycle	On-demand-MI after ... cycle		
SCR System Dosing Valve	P 2...	not tested		-	-	-	A	A	6.3.2.1	WHTC	yes	6.3.1	WHTC	2nd				
EGR Valve Electrical	P 1...	not tested					A	B1	6.3.2.1	WHTC	yes	6.3.1	WHTC		1st			
EGR Valve Mechanical	P 1...	not tested					B1	B1	6.3.2.1	WHTC	yes	6.3.1	WHTC		2nd			
EGR Valve Mechanical	P 1...	6.2.2	WHTC		X		B1	B1	not tested		yes							
EGR Valve Mechanical	P 1...	6.2.2	WHTC		X		B1	B1	6.3.2.1	WHTC	yes	6.3.1	WHTC		2nd			
Air Temp. Sensor Electrical	P 1...	Not tested					B2	B2	6.3.2.2	WHTC	yes	6.3.1	WHTC		1st			
Oil Temp. Sensor Electrical	P 1...	6.2.6	ETC			X	C	C	not tested		yes							

Remarks: 1) Upon request of the certification authority the failure may be re-classified into a class diferent from the one proposed by the manufacturer.

Only the failures that have been tested either for classification or for performance and the failures that have been reclassified at the certification authority request are listed in this sheet

A malfunction may be tested either for its classification, or for its performance, or for both.
Example given of the EGR mechanical valve gives the way each of these 3 cases are considered in the table

Annex 11 - Appendix 5

FREEZE FRAME AND DATA STREAM INFORMATION

The following tables list the pieces of information that are considered in paragraphs 4.7.1.4. and 4.7.2. of this annex.

Table 1: MANDATORY REQUIREMENTS:

	Freeze frame	Data stream
Calculated load (engine torque as a percentage of maximum torque available at the current engine speed)	x	x
Engine speed	x	x
Engine coolant temperature (or equivalent)	x	x
Barometric pressure (directly measured or estimated)	x	x

Table 2: OPTIONAL ENGINE SPEED AND LOAD INFORMATION:

	Freeze frame	Data stream
driver's demand engine torque (as a percentage of maximum engine torque)	x	x
actual engine torque (calculated as a percentage of maximum engine torque, e.g. calculated from commanded injection fuel quantity)	x	x
reference engine maximum torque		x
reference maximum engine torque as a function of engine speed		x
time elapsed since engine start	x	x

Table 3: OPTIONAL INFORMATION, IF USED BY THE EMISSION OR THE OBD SYSTEM TO ENABLE OR DISABLE ANY OBD INFORMATION

	Freeze frame	Data stream
fuel level	x	x
Engine oil temperature	x	x
vehicle speed	x	x
engine control computer system voltage (for the main control chip)	x	x

Table 4: OPTIONAL INFORMATION, IF THE ENGINE IS SO EQUIPPED, SENSES OR CALCULATES THE INFORMATION:

	Freeze frame	Data stream
Absolute throttle position / intake air throttle position (position of valve used to regulate intake air)	x	x
Diesel fuel control system status in case of a close loop system (e.g. in case of a fuel pressure close loop system)	x	x
Fuel rail pressure	x	x
Injection control pressure (i.e. pressure of the fluid controlling fuel injection)	x	x
Representative fuel injection timing (beginning of first main injection)	x	x
Commanded fuel rail pressure,	x	x
Commanded injection control pressure (i.e. pressure of the fluid controlling fuel injection)	x	x
Intake air temperature	x	x
Ambient air temperature	x	x
Turbocharger inlet / outlet air temperature (compressor and turbine)	x	x
Turbocharger inlet / outlet pressure(compressor and turbine)	x	x
Charge air temperature (post intercooler if fitted)	x	x
Actual boost pressure	x	x
Air flow rate from mass air flow sensor	x	x
Commanded EGR valve duty cycle/position, (provided EGR is so controlled)	x	x
Actual EGR valve duty cycle/position	x	x
PTO status (active or not active)	x	x
Accelerator pedal position	x	x
Redundant absolute pedal position	x	if sensed
Instantaneous fuel consumption	x	x
Commanded/target boost pressure (if boost pressure used to control turbo operation)	x	x
DPF inlet pressure	x	x
DPF outlet pressure	x	x
DPF delta pressure	x	x
Engine-out exhaust pressure	x	x
DPF inlet temperature	x	x
DPF outlet temperature	x	x
Engine-out exhaust gas temperature	x	x
Turbocharger/turbine speed	x	x
Variable geometry turbo position	x	x
Commanded variable geometry turbo position	x	x
Wastegate valve position	x	x
Air/fuel ratio sensor output		x
Oxygen sensor output		x
NO_x sensor output		x

REFERENCE STANDARD DOCUMENTS

This appendix contains the references to the industry standards that are to be used in accordance to the provisions in this annex to provide the serial communications interface to the vehicle/engine. There are three allowed solutions identified, ISO 15765-4 or SAE J1939-73 or ISO/PAS 27145. In addition there are other ISO or SAE standards that are applicable in accordance to the provisions in this annex.

ISO 15765-4 and those specifications included by reference therein to accomplish the WWH-OBD requirements.
ISO 15765-4 "Road vehicles - Diagnostics on Controller Area Network (CAN) - Part 4: Requirements for emissions-related systems", dated on year 2006.

SAE J1939-73 and those specifications included by reference therein to accomplish the WWH-OBD requirements.
J1939-73 "APPLICATION LAYER - DIAGNOSTICS", dated on year 2006.

ISO/PAS 27145 and those specifications included by reference therein to accomplish the WWH-OBD requirements.

(i) ISO/PAS 27145-1:2006 Road vehicles - On board diagnostics (WWH-OBD) implementation - Part 1 - General Information and use case definitions
(ii) ISO/PAS 27145-2:2006 Road vehicles – Implementation of WWH-OBD communication requirements - Part 2 - Common emissions-related data dictionary;
(iii) ISO/PAS 27145-3:2006 Road vehicles – Implementation of WWH-OBD communication requirements - Part 3 - Common message dictionary;
(iv) ISO/PAS 27145-4:2006 Road vehicles – Implementation of WWH-OBD communication requirements - Part 4 - Connection between vehicle and test equipment;

The following International Organization of Standards (ISO) documents are incorporated by reference into this Regulation:
ISO 15031-3:2004 "Road vehicles — Communication between vehicle and external equipment for emissions-related diagnostics — Part 3: Diagnostic connector and related electrical circuits, specification and use".

The following Society of Automotive Engineers (SAE) (ISO) documents are incorporated by reference into this Regulation:
SAE J2403 "Medium/Heavy-Duty E/E Systems Diagnosis Nomenclature", dated on August 2004.
SAE J1939-13 "Off-Board Diagnostic Connector", dated on March 2004.

Annex 11 - Appendix 7

DOCUMENTATION REGARDING OBD RELATED INFORMATION

The OBD related information requested by this appendix shall be provided by the vehicle manufacturer for the purposes of enabling the manufacture of OBD-compatible replacement or service parts and diagnostic tools and test equipment in the manner prescribed in the main part of this Regulation.

REPLACEMENT PARTS, DIAGNOSTIC TOOLS AND TEST EQUIPMENT

The 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.

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.

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.

REPAIR INFORMATION

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.

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.

In the event of failure to comply with these provisions the administrative department 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. "

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