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## Economic Commission for Europe

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World Forum for Harmonization of Vehicle Regulations

Working Party on Pollution and Energy

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Item 4(b) of the provisional agenda

**Heavy duty vehicles – Worldwide harmonized Heavy**

**Duty On-Board Diagnostic systems**

### **Proposal for Amendment 1 to global technical regulation No. 5**

**Submitted by the expert from the European Commission \***

The text reproduced below was prepared by the expert from the European Commission (EC) to introduce amendments to the test procedures in global technical regulation (gtr) No. 5 on worldwide harmonized requirements for on-board diagnostic systems (WWH-OBD). This document proposes amending the provisions of gtr No. 5 to clarify a number of concerns identified by the experts from EC during the preparation of legislation implementing the Euro VI emission levels (i.e. Regulation (EC) 595/2009).

It is noted that the proposed amendments shall be considered in parallel with a separate amendment to Annexes 9B and 9C of Regulation No. 49 (see document ECE/TRANS/WP.29/GRPE/2011/16). The modifications to the current text of the Regulation are marked in bold for new or strikethrough for deleted characters.

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\* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106 and ECE/TRANS/2010/8, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

## I. Proposal

*In the text of the regulation (part B)*

*Module A*

*Paragraph 4.4.1., amend to read:*

"4.4.1. Access to OBD information

.....

Access to OBD information shall be provided using, at least one of the following series of standards mentioned in Annex 1:

- (a) ~~ISO/PAS-27145~~ **ISO 27145 with ISO 15765-4** (CAN-based)
- (b) ISO 27145 **with ISO 13400** (TCP/IP-based)
- (c) SAE J1939-71 **and SAE J1939-73"**

A Contracting Party may decide if and when to require only the use of ISO 27145 5/.

**Manufacturers shall use appropriate ISO or SAE-defined fault codes (for example, P0xxx, P2xxx) whenever possible. If such identification is not possible, the manufacturer may use diagnostic trouble codes according to the relevant clauses in ISO 27145 or SAE J1939. The fault codes must be fully accessible by standardized diagnostic equipment complying with the provisions of this Module.**

**The manufacturer shall provide the ISO or SAE standardization body through the appropriate ISO or SAE process with emission-related diagnostic data not specified by ISO 27145 or SAE J1939 but related to this Module."**

*Paragraph 9., amend to read:*

"9. ANNEXES

Annex 1 contains the references to the industry standards that are to be used in accordance to the provisions of this gtr to provide the serial communications interface to the vehicle/engine. There are **two** allowed solutions identified:

- (a) **ISO 27145 with either ISO 15765-4 (CAN based) with either ISO 15765-4 (CAN based) or with ISO 13400 (TCP/IP based);**
- (b) SAE J1939-73.

In addition there are other ISO or SAE standards that are applicable in accordance with the provisions of this gtr."

*Annex 1, paragraph 2.1.2.1.1., amend to read:*

"REFERENCE STANDARD DOCUMENTS

~~ISO 15765-4:2005~~ **ISO 27145** and those specifications included by reference therein to accomplish the WWH-OBd requirements, **with either**

- (a) ISO 15765-4:2005 "Road vehicles — Diagnostics on Controller Area Network (CAN) — Part 4: Requirements for emissions-related

systems" and those specifications included by reference therein to accomplish the WWH-OBD requirements, or

- (b) **ISO 13400:20xx "...(TCP/IP)..." and those specifications included by reference therein to accomplish the WWH-OBD requirements.**

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

~~ISO 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.~~

**Reference by this gtr to ISO 27145 means reference to those standards and those specifications included by reference therein to accomplish the WWH-OBD requirements:**

- (a) **ISO 27145-1 Road vehicles — Implementation of WWH-OBD communication requirements - Part 1 — General Information and use case definitions;**
- (b) **ISO 27145-2 Road vehicles — Implementation of WWH-OBD communication requirements — Part 2 — Common emissions-related data dictionary;**
- (c) **ISO 27145-3 Road vehicles — Implementation of WWH-OBD communication requirements — Part 3 — Common message dictionary;**
- (d) **ISO 27145-4 Road vehicles — Implementation of WWH-OBD communication requirements — Part 4 — Connection between vehicle and test equipment.**

The following Society of Automotive Engineers (SAE) ~~(ISO)~~ documents are incorporated by reference into this Regulation:

....."

*Module B*

*Paragraph 3.24., amend to read:*

- "3.24. *"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~~ **by an external request or command (for example through an OBD scan-tool).**"

Paragraph 4.2.2.1., amend to read:

"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 1/, and
- (c) the failure does not affect a component or system enabling the proper performance of the OBD system, **and**
- (d) **the failure does not substantially delay or affect the ability of the emission control system to operate as originally designed (for example a breakdown of the reagent heating system under cold conditions cannot be considered as an exception).**

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 module.

**When such a demonstration would not be conclusive regarding criterion (d), the manufacturer shall submit to the approval authority appropriate design elements such as good engineering practice, technical considerations, simulation, test results, etc."**

Paragraph 4.2.3., amend to read:

"4.2.3. Monitoring frequency

.....

~~When a monitor does~~ **At the request of the manufacturer, the certification authority may approve monitors that do not run continuously, the manufacturer shall clearly inform the Approval Authority and describe the conditions under which the monitor runs and justify the proposal by appropriate design elements (such as good engineering practice).**

The monitors .....

A monitor shall be regarded as running continuously, if it **samples at** a rate not less than **twice** per second **and concludes the presence or the absence of the failure relevant to that monitor within 15 seconds**. If a computer input or output component is sampled less frequently than **twice** per second for engine control purpose, a monitor shall also be regarded as running continuously, if the **system concludes the presence or the absence of the failure relevant to that monitor** each time sampling occurs."

Paragraph 4.3., correct to read:

"4.3. Requirements for recording OBD information

.....

In case a malfunction with the previously active status occurs again, that malfunction may at the choice of manufacturer be directly given the "Pending DTC " and "confirmed and active DTC" status. ~~Without~~ **without** having been given the "potential DTC" status. If that malfunction ...

....."

*Paragraph 4.6.1, amend to read:*

"4.6.1. MI specification

The malfunction indicator shall be a visual signal that is perceptible 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. 37) warning signal identified by the ~~F01-0640~~ symbol in accordance with ISO standard ~~2575:2004~~ **7000:2004**."

*Paragraph 4.6.3.1.4., amend to read:*

"4.6.3.1.4. ....

The "short-MI" shall be deactivated if the malfunction is not detected during the 3 subsequent sequential operating sequences **following the operating sequence when the monitor has concluded the absence of the considered malfunction** and the MI is not activated due to another Class A or B malfunction.

**Figures 1, 4 and 4bis in Annex 2 illustrate respectively the short and continuous MI deactivation in different use-cases."**

*Paragraph 4.6.4., amend to read (inserting also footnote <sup>1</sup>):*

"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** <sup>1</sup> (**engine-on**) or the key is set to the key-off position.

**At the request of the manufacturer, this activation may only occur once during an operating sequence (e.g. in case of start-stop systems)."**

*Paragraph 4.6.4.2., amend to read:*

"4.6.4.2. Presence / absence of a malfunction

Following the sequence described in paragraph 4.6.4.1, the MI shall .....  
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 **4 seconds** with the MI off.

....."

*Paragraph 4.7.1.5., amend to read:*

"4.7.1.5. Readiness

<sup>1</sup> An engine may be considered started during the cranking phase.

**With the exceptions specified in paragraphs 4.7.1.5.1., 4.7.1.5.2. and 4.7.1.5.3., a readiness shall only be set to "complete" when a monitor or a group of monitors addressed by this status have run and concluded the presence (that means stored a confirmed and active DTC) or the absence of the failure relevant to that monitor since the last erasing by an external request or command (for example through an OBD scan-tool).**

Readiness shall be set to "not complete" by erasing the fault code memory (see paragraph 4.7.4.) ~~of a monitor or group of monitors~~ by an external request or command (for example through an OBD scan-tool).

Normal engine shutdown shall not cause the readiness to change."

*Insert new paragraphs 4.7.1.5.1 to 4.7.1.5.3., to read:*

**4.7.1.5.1** The manufacturer may request, subject to approval by the Approval Authority, that the ready status for a monitor be set to indicate "complete" **without the monitor having run and concluded the presence or the absence of the failure relevant to that monitor** 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".

**4.7.1.5.2. Monitors subject to readiness**

**Readiness shall be supported for each of the monitors or groups of monitors that are identified in this module and that are required when and by referring to this module, with the exception of appendices 11 and 12 of Annex 3.**

**4.7.1.5.3. Readiness for continuous monitors**

**Readiness of each of the monitors or groups of monitors, that are identified in Appendices 1, 7 and 10 of Annex 3 to this module and that are considered by this module as running continuously, shall always indicate "complete"."**

*Paragraph 5.2.2., amend to read:*

"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) **at ambient engine start temperatures below 266 K (-7 degrees Celsius or 20 degrees Fahrenheit) in the case where the coolant temperature has not reached a minimum temperature of at least 333 K (60 degrees Celsius or 140 degrees Fahrenheit), or**
- (b) **at ambient temperatures below 266 K (-7 degrees Celsius or 20 degrees Fahrenheit) in the case of frozen reagent, or**
- (c) **at ambient temperatures above 308 K (35 degrees Celsius or 95 degrees Fahrenheit), or**
- (d) **at elevations above 2,500 meters (8,202 feet) above sea level.**

A manufacturer may further request approval that an OBD system monitor be **temporarily** disabled at other ambient ~~engine-start~~temperatures **and altitude conditions** 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, **effect on the compatibility with sensor tolerances**).

Note:           ....."

*Paragraph 6.3.2.1., amend to read:*

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

**6.3.2.1.1.     Emission threshold monitoring**

In the case the malfunction selected by the ~~Approval~~ **certification** Authority 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.

**6.3.2.1.2.     Performance monitoring**

**At the request of the manufacturer and with the agreement of the certification authority, in the case of performance monitoring, the OTL may be exceeded by more than 20 per cent. Such request shall be justified on a case by case basis.**

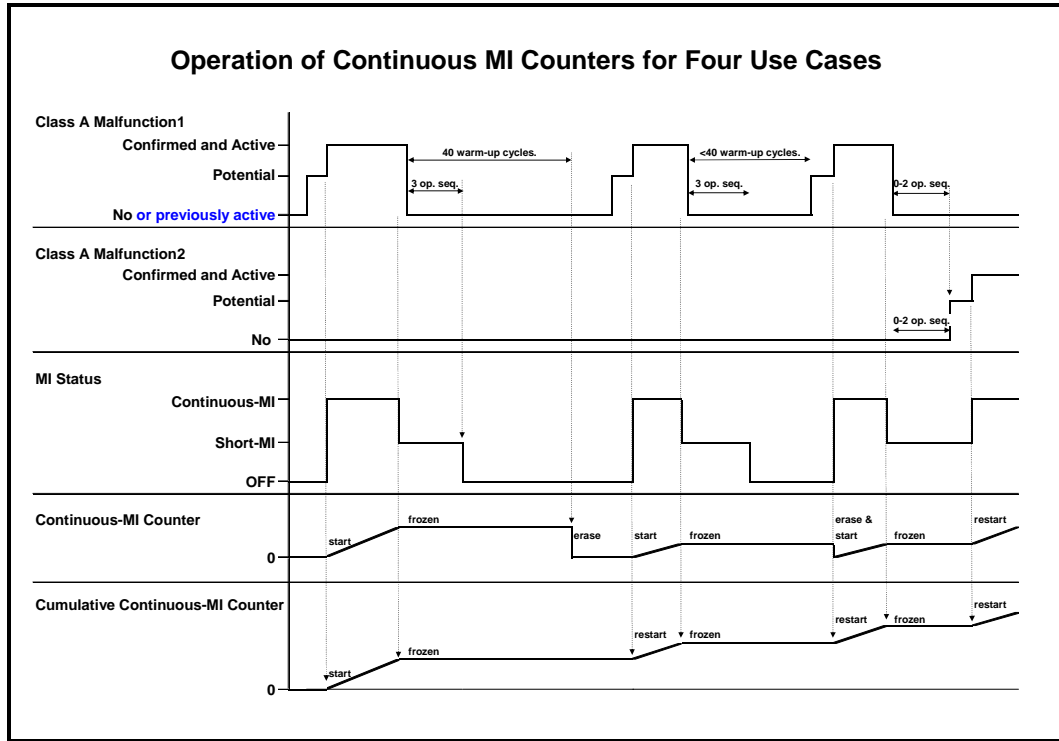
**6.3.2.1.3.     Component monitoring**

**In the case of component monitoring, a deteriorated component is qualified without reference to the OTL."**

Module B, Annex 2

Figure 4, amend to read:

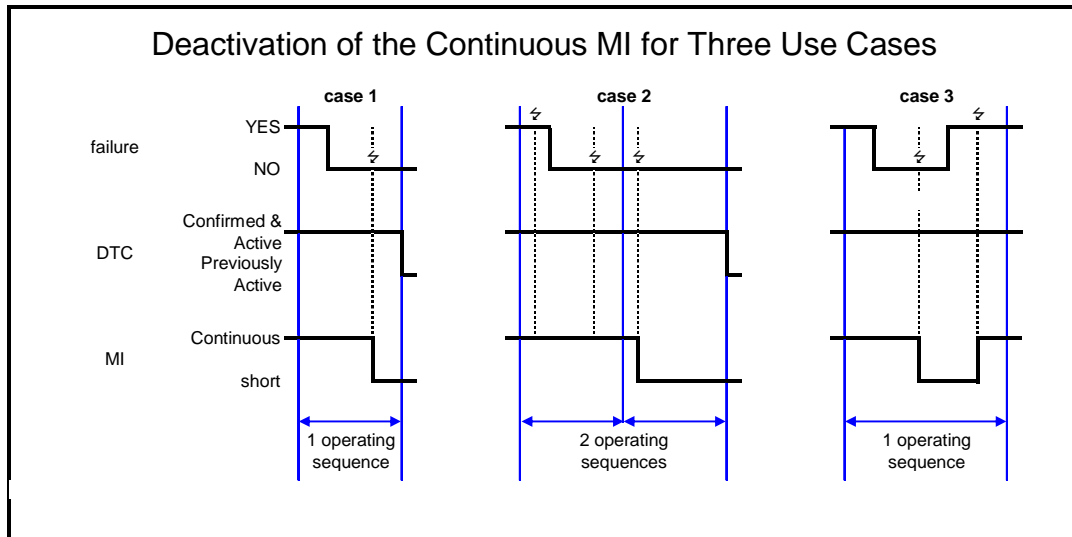
"



**Note:** Details related to the deactivation of the continuous MI are illustrated in figure 4bis below in the specific case where a potential state is present."

Insert a new figure 4bis, to read:

**"Figure 4bis:** Illustration of the continuous MI deactivation principle





**Notes:**

- ↶ means the point where monitoring of the concerned malfunction occurs.
- M** means the operating sequence when the monitor concludes for the first time that a confirmed and active failure is no longer present.
- case 1** means the case where the monitor does not conclude the presence of failure during the operating sequence M.
- case 2** means the case where the monitor has previously concluded, during the operating sequence M, the presence of the malfunction.
- case 3** means the case where the monitor concludes, during the operating sequence M, the presence of the malfunction after having first concluded to its absence."

*Module B, Annex 3*

*Appendix 1*, amend to read:

"Electric/ .....

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.

**In the case where the control of reagent injection is performed by means of a closed loop system, the monitoring requirements set out in this Appendix shall apply, but the failures detected shall not be classified as class C failures."**

*Appendix 2*, amend to read:

"The OBD system .....

The following enhanced monitoring requirements may also be introduced into regional regulation, where determined to be technically feasible by a Contracting Party at the time of introduction of that regulation:

- (a) DPF filtering performance: the filtering ~~capability~~ **and continuous regeneration process of the DPF**. This requirement would apply to PM emissions only — emission threshold monitoring.

....."

*Appendix 6*, complete to read:

"The OBD system .....

- (b) EGR cooler performance: the EGR cooler system's ability to achieve the manufacturer's specified cooling performance - emission threshold monitoring.

- (c) **EGR low flow<sup>2</sup>: the EGR system's ability to maintain the commanded EGR flow rate, detecting "flow rate too low" conditions — total functional failure or performance monitoring<sup>3</sup>**

<sup>2</sup> This requirement applies in addition to the base requirement (a) of this appendix

- (d) **EGR cooler undercooling performance<sup>4</sup>: the EGR cooler system's ability to achieve the manufacturer's specified cooling performance — total functional failure monitoring.<sup>3</sup> "**

Appendix 8, complete to read

"The OBD system .....

- (c) Charge air cooling: Charge air cooling system efficiency - emission threshold monitoring.
- (d) **Turbo under boost<sup>5</sup>: turbo boost system's ability to maintain the commanded boost pressure, detecting "boost pressure too low" conditions — total functional failure or performance monitoring.<sup>6</sup> "**

## II. Justification

### 1. References to ISO and SAE standards regarding OBD Communication protocols, Module A - paragraph 4.4.1, paragraph 9, and Annex 1:

- (a) Reference to the temporary ISO/PAS document will become obsolete when the ISO document will be issued (third Quarter of 2011).

Reference to SAE J1939-71 should be completed by reference to SAE J1939-73 because SAE J1939-71 is the vehicle application layer, while SAE J1939-73 is the diagnostic / scan tool layer.

- (b) The concerned paragraphs require the manufacturer to use one of the listed standards. However it does not require the manufacturer to only use the DTC's defined in these standards and permits, when allowed by these standards, to use without further limitation manufacturer specific DTC's.

In the United States' rules, it is described when and how the certification authority may permit such an usage:

*"The lack of available SAE-defined fault codes, uniqueness of the diagnostic or monitored component, expected future usage of the diagnostic or component, and estimated usefulness in providing additional diagnostic and repair information to service technicians. Manufacturer-defined fault codes shall be used consistently (i.e., the same fault code may not be used to represent two different failure modes) across a manufacturer's entire product line".*

It is proposed to require from the manufacturer to use first the standardized codes, and, when such a code is not available refer to the concerned standardization body, in view of possibly creating a new code. This measure aims at avoiding non-harmonized durable interpretation and at restricting to a limited period of time an extensive usage of manufacturer specific codes.

- (c) Referring to ISO 15765-4 as a third implementation option would lead to the assumption that solely by implementing ISO 15765-4 WWH-OBD access to OBD information requirements can be fulfilled. However, the requirements in this gtr

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<sup>3</sup> The failures so detected shall not be classified as class C failures.

<sup>4</sup> This requirement applies in addition to the base requirement (c) of this appendix.

<sup>5</sup> This requirement applies in addition to the base requirement (a) of this appendix.

<sup>6</sup> The failures detected shall not be classified as class C failures.

cannot be fulfilled by implementing ISO 15765-4 only. To be able to fulfil the requirements established by this gtr it is obligatory to implement ISO 27145 (parts 1-4). Options for implementing ISO 27145 are either ISO 27145 on CAN, for this use case ISO 15765-4 would apply in addition, or ISO 27145 on DoIP (TCP/IP), for this use case ISO 13400 would apply in addition.

Due to the fact that the 2006's PAS specifications are no longer available, it is proposed to refer to the corresponding ISO standards.

## **2. Elements concerning readiness, Module B, paragraph 3.24. and paragraph 4.7.1.5.**

It is not sufficient enough that the monitor has run for setting the readiness to "complete". It should arrive to a conclusion. Not allowing the readiness be set to complete by e.g. radio turn on is also necessary.

Paragraph 4.7.4. stipulates that it is not allowed to clear the fault code memory of a specific monitor or a specific group of monitors by means of a scan tool or maintenance tool. Only "all DTCs" may be (simultaneously) erased. It is common practice to apply this requirement.

In that respect, the last sentence of paragraph 4.5.1.5. needs to be amended for ensuring consistency in the requirements. By deleting the words "of a monitor or group of monitors" the problem would be solved.

New paragraphs are added to improve the world harmonized character of the gtr by adapting the Californian requirements for 2013 that states (CARB 1971.1).

## **3. Temporary OBD disablement, paragraph 5.2.2.**

Amendment to paragraph 5.2.2. aims at solving the case of an engine cold start with frozen reagent that is shut down after a short time with a still frozen reagent (i.e. before the 70 min when severe inducement would occur) and then started again.

In that case the "ambient engine start temperature" for the second start is relatively high, because the engine compartment has been warmed-up during the first engine run. In this situation, paragraph 5.2.2. does not allow disabling monitors even that the AdBlue is frozen leading to misdiagnosis.

Engine start refers to the engine-warm-up that is defined through definition 3.29., that states:

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

## **4. MI deactivation scheme, paragraph 4.6.3.1.4. and Annex 2**

- (a) The second paragraph of paragraph 4.6.3.1.4. may be understood as if the short MI should be switched off after three complete operating sequences with no failure detected, even if the failure was present and not detected in most of that sequence. This understanding is in contradiction with common interpretation as illustrated in figures 1 and 4 of Annex 2.

The amendment aims at avoiding this misinterpretation.

Reference to the figures in Annex 2 is recommended for understanding the meaning of this paragraph.

- (b) The continuous MI is deactivated as soon as the monitor has concluded the absence of the malfunction. On the contrary, the status of the malfunction changes from confirmed and active to previously active at the end of the operating sequence.

Details of this mechanism are illustrated in a new figure 4bis, but figure 4 needs to be modified accordingly.

This new figure aims at illustrating the continuous MI deactivation scheme in 3 typical cases and at reinforcing the consistency between the figures and paragraph 4.6.3.1.4.

**5. Key-on – Engine-off display, paragraph 4.6.4.**

- (a) In order not to unnecessarily disturb the driver, repeated starting by start-stop systems shall not automatically generate the activation of the display.
- (b) When a malfunction has been detected by the system, the principle of the display requested in paragraph 4.6.4.2. is based on an illumination code where the illumination is either continuous, or periodic.

In case of a periodic illumination, each illumination sequence consists of a series of flashes separated by a MI-off period. To avoid any confusion, the duration of this periodic MI-off period was determined to be the same as the duration of the MI-off period between the readiness display and the malfunction display that is 5 second. This principle is correctly illustrated in figure B2.

The current text needs to be corrected because it indicates that the duration shall be 5 + 1 second due to the fact that the first second is counted twice!

**6. Procedure for failure qualification, paragraph 6.3.2.1.**

- (a) In the case of performance monitoring, no correlation to actual emissions is required (paragraph 4.2.1.1.). Accordingly, the 20 per cent maximum value may not always be applicable to performance monitoring, depending on the type of monitoring. For example, monitoring lack of reagent dosing (which is typically a performance monitoring) may lead to increased emissions (higher than 20 per cent).
- (b) Component monitoring may result in emissions that are not correlated to the OTL. Accordingly, the 20 per cent maximum value may not be applicable to component monitoring.

**7. Continuous monitor, paragraph 4.2.3.**

In principle the certification authority should maintain the right not to accept a manufacturer's proposal that could not be justified.

The current wording of paragraph 4.2.3. may lead to an abusive interpretation where a monitor could sample at a frequency greater than 2 Hz, have a relatively high evaluation time (e.g. 2 minutes) and still be considered as running continuously.

On the other side the current text wisely addresses the fact that the technology development does permit, in many cases, a monitor that could sample and evaluate that sample at a frequency greater than 2 Hz.

Paragraph 4.2.3. proposes to limit the evaluation time of a continuous monitor to a feasible value such as 15 seconds.

**8. Component monitoring, paragraph 4.2.2.1.**

Avoid the loop-hole saying that such devices like the urea heating system do not need to be monitored.

**9. Editorial errors, paragraphs 4.3. and 4.6.1.**

**10. Additional requirements concerning the monitors, Appendices 6, 8, 1 and 2**

Introduce into Appendices 6 and 8 to Annex 3 changes that may permit regional authorities to consider some types of plausible double failures (enhanced optional monitors) and clarify some points on the monitors specified in Appendices 1 and 2 to Annex 3.

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