

OBD DEMONSTRATION PROCEDURE FOR MALFUNCTIONS WHICH CAUSE DEFAULT ACTION WITH INCREASED EMISSIONS INCL. ACEA&CLEPA PROPOSAL_V2 FOR MODIFICATION (SLIDES 10-13)

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Malfunctions which cause default action with increased emissions

Explanation of Scenario (example)

- ▶ Some malfunctions, when detected, will and must cause some kind of default action*.
- ▶ The default action can cause a significant increase of emissions, e.g. significantly higher than OBD threshold limit.
- ▶ Example “oxygen sensor”:
 - ▶ Specific oxygen sensor malfunctions, when detected, will and must cause deactivation of lambda control.
 - Reason: malfunctioning oxygen sensor cannot deliver valid lambda value, such that lambda control is no longer possible (technical consequence, no other solution possible)
 - ▶ After deactivation of lambda control, precise adjusting of lambda to 1.0 is no longer possible, especially at change of engine operation point (i.e. at usual dynamic driving).
 - ▶ Without precise adjusting of lambda to 1.0, the catalyst conversion capability will be reduced significantly, such that emissions will exceed OBD threshold limits significantly.

* default action: roughly corresponds to EOBD term “emission default mode of operation” (not necessarily permanent)

Malfunctions which cause default action with increased emissions

OBD certification demonstration – example oxygen sensor

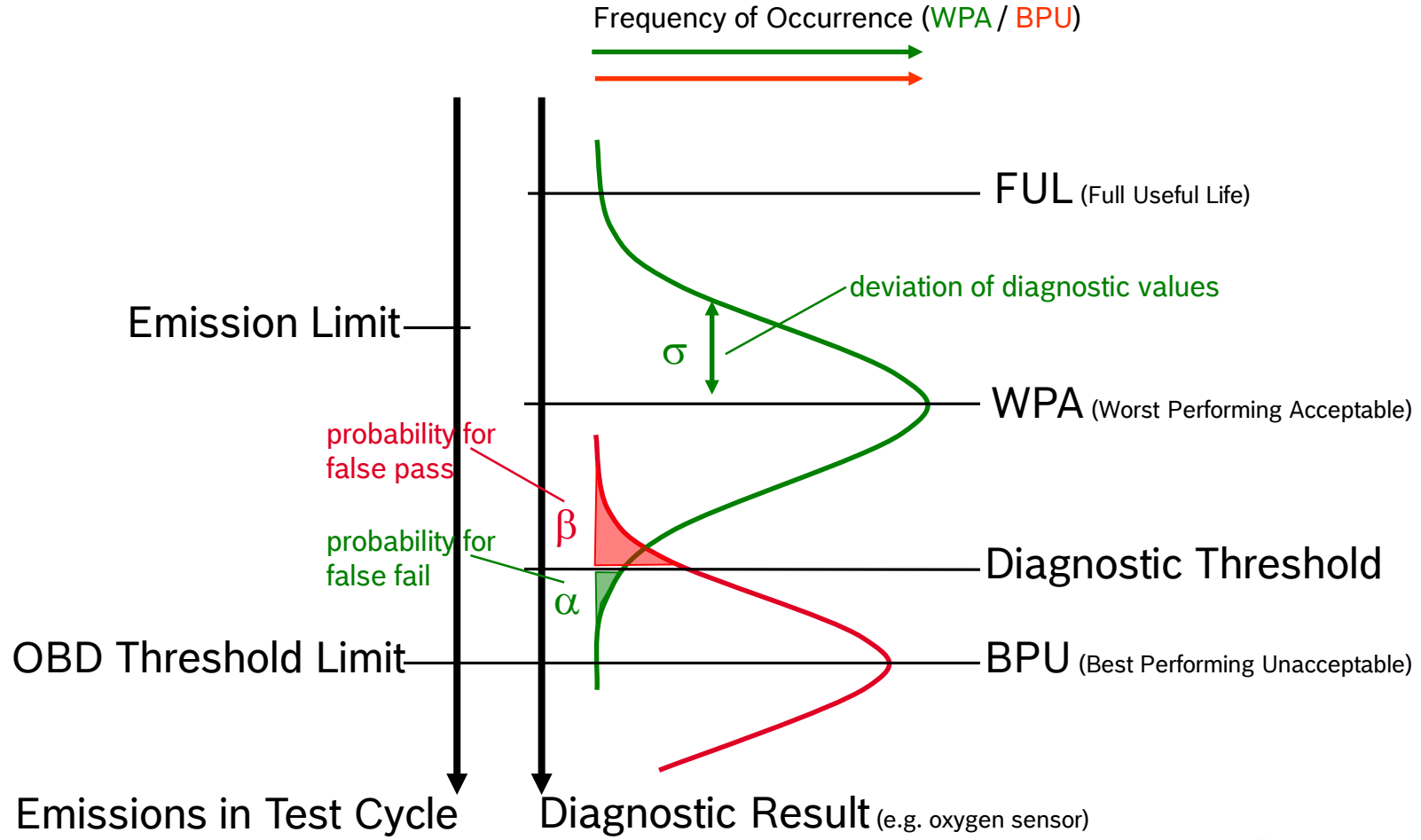
- ▶ After implementation of a faulty oxygen sensor with the fault size as needed for OBD certification demonstration (i.e. to the best performing unacceptable (BPU) level for detecting the malfunction & storing a fault code & illuminating MI), the default action will cause the emissions to exceed OBD threshold limits significantly
 - not acceptable without any *countermeasure* (possible countermeasure: see below)
- ▶ An oxygen sensor which has deteriorated to the worst possible level, which will not cause malfunction detection & storing a fault code & illuminating MI (i.e. to the worst performing acceptable (WPA) level), would not cause emissions to exceed OBD threshold limits.
- ▶ Possible *Countermeasure* (in alignment with CARB OBD II):
 - ▶ Re-testing with reduced fault size (i.e. to the worst performing acceptable (WPA) level), such that no malfunction detection & no storing a fault code & no illuminating MI will happen
 - ▶ Remark: deteriorated oxygen sensor might (usually) be simulated by external HW tool
- ▶ Further explanation of BPU & WPA: see next slide

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WPA & BPU & Diagnostic Threshold

CARB/OEM terminology:

- ▶ Best Performing Unacceptable (BPU): This term refers to a system/component that yields performance measurements (as determined by the monitoring strategy) that are failing just beyond the malfunction criteria established by the manufacturer (i.e., the diagnostic or fault threshold). Components or systems operating at this level of deterioration or worse should be detected as malfunctioning by the OBD system and illuminate the MIL.
- ▶ Worst Performing Acceptable (WPA): This term refers to a system/component with performance that has deteriorated to the limit of the manufacturer's criteria for acceptable performance. The MIL should not be illuminated for a component performing at this level of deterioration or better. A component or system performing worse than this level of deterioration would not be within the manufacturer's criteria for acceptable performance, but may still be good enough to pass the diagnostic (i.e. no MIL illumination).



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CARB OBD II wording 2013

13CCR1968.2, July 31, 2013

- ▶ (h) *Monitoring System Demonstration Requirements For Certification*
- ▶ ...
- ▶ (6) *Evaluation Protocol:*
- ▶ ...
- ▶ (6.4) If the MIL does not illuminate when the systems or components are set at their limit(s), the criteria limit or the OBD II system is not acceptable.
- ▶ (6.4.1) Except for testing of the catalyst (i.e., components monitored under (e)(1), (f)(2) or (f)(8)) or PM filter system, if the MIL first illuminates after emissions exceed the applicable malfunction criteria specified in sections (e) and (f), the test vehicle shall be retested with the tested system or component adjusted so that the MIL will illuminate before emissions exceed the applicable malfunction criteria specified in sections (e) and (f). If the component cannot be adjusted to meet this criterion because a default fuel or emission control strategy is used when a malfunction is detected (e.g., open loop fuel control used after an O2 sensor malfunction is determined, etc.), the test vehicle shall be retested with the component adjusted to the worst acceptable limit (i.e., the applicable monitor indicates the component is performing at or slightly better than the malfunction criteria). For the OBD II system to be approved, the MIL must not illuminate during this test and the vehicle emissions must be below the applicable malfunction criteria specified in sections (e) and (f).

This older version of CARB OBD II has been chosen, because the paragraph is somewhat short and comprehensible.

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CARB OBD II wording 2016

- ▶ In the **current version 13CCR1968.2, July 25, 2016**, the same paragraph (h)(6.4.1) has been further developed by CARB, thus more detailed and maybe somewhat challenging (i.e. not so easy to understand all details of the wording), while the basic sense is still the same.
- ▶ This **current version** can be found via the following LINK on top of the page “**Clean Versions of the Latest OAL-Approved OBD II Regulations**” --> Section 1968.2: (PDF - 1123K) **(OAL-approved on July 25, 2016)** :
<https://ww3.arb.ca.gov/msprog/obdprog/obdregs.htm>

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CARB OBD II wording 2016

13CCR1968.2, July 25, 2016

- ▶ (h) *Monitoring System Demonstration Requirements For Certification*
- ▶ ...
- ▶ (6) *Evaluation Protocol:*
- ▶ ...
- ▶ (6.4) If the MIL does not illuminate when the systems or components are set at their limit(s), the criteria limit or the OBD II system is not acceptable.
- ▶ (6.4.1) *see next page*

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CARB OBD II wording 2016

13CCR1968.2, July 25, 2016

- ▶ (h)(6.4.1) If the MIL first illuminates after emissions exceed the applicable emission threshold malfunction criteria specified in sections (e) and (f), the test vehicle shall be retested with the tested system or component adjusted so that the MIL will illuminate without emissions exceeding the applicable emission threshold malfunction criteria specified in sections (e) and (f). If the system or component cannot be adjusted to meet this criterion because a default fuel or emission control strategy is used when a malfunction is detected (e.g., open loop fuel control used after an O2 sensor malfunction is determined, etc.), the test vehicle shall be retested with the system or component adjusted to the worst acceptable limit (i.e., the applicable monitor indicates the system or component's performance is passing but at the closest possible value relative to the monitor threshold value at which a fault would be detected that would invoke the default strategy and illuminate the MIL). The manufacturer may request the Executive Officer to accept test data when the system or component's performance is at the worst acceptable limit within a margin of error necessary to accommodate testing variability and/or other practical limitations in setting the performance at the absolute worst acceptable limit. The Executive Officer shall accept the test data upon determining that the test data adequately demonstrate that emissions do not exceed the applicable malfunction criteria at the tested worst acceptable limit and that emissions will not exceed the applicable emission threshold malfunction criteria before performance exceeds the monitor threshold for fault detection. These provisions shall only apply to testing of the catalyst (i.e., components monitored under sections (e)(1.2), (f)(1.2.2), (f)(2.2.2), and (f)(8.2.1)) or PM filter system (i.e., (f)(9.2.1) and (f)(9.2.4)(A)) if the on-board computer invokes a default fuel or emission control strategy upon detection of the relevant catalyst malfunction. Otherwise, the provisions of section (h)(6.4.2) shall apply to testing of the catalyst or PM filter system.

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CARB OBD II wording 2016

13CCR1968.2, July 25, 2016

- ▶ (h)(6.4.2) Except as provided for in section (h)(6.4.1), in testing the catalyst (i.e., components monitored under (e)(1), (f)(2) or (f)(8)) or PM filter system, if the MIL first illuminates after emissions exceed the applicable emission threshold malfunction criteria specified in sections (e) and (f), the tested vehicle shall be retested with a less deteriorated catalyst or PM filter system (i.e., more of the applicable engine out pollutants are converted or trapped). Adjustment and testing of the catalyst or PM filter system's performance may be repeated until successful results are obtained. For the OBD II system to be approved, either of the following conditions must be satisfied by the test results:
 - ▶ (A) The MIL is illuminated and emissions do not exceed the emission threshold malfunction criteria specified in sections (e) and (f); or
 - ▶ (B) The manufacturer demonstrates that the MIL illuminates within acceptable upper and lower limits of the malfunction criteria specified in sections (e) and (f) for MIL illumination. The demonstration shall be deemed appropriate when the test results show:
 - (i) The MIL is illuminated and emissions exceed the emission threshold malfunction criteria specified in sections (e) and (f) by 25 percent or less of the applicable standard (e.g., emissions are less than 2.0 times the applicable standard for an emission threshold malfunction criterion of 1.75 times the standard); and
 - (ii) The MIL is not illuminated and emissions are below the emission threshold malfunction criteria specified in sections (e) and (f) by no more than 25 percent of the standard (e.g., emissions are between 1.5 and 1.75 times the applicable standard for an emission threshold malfunction criterion of 1.75 times the standard).

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UN Regulation No. 83, Suppl.8 to 07 [28.05.2019] → ACEA&CLEPA PROPOSAL

ANNEX 11 - APPENDIX 1

6.4 OBD system test

6.4.1 Vehicles fitted with positive ignition engines:

6.4.1.1 After vehicle preconditioning according to paragraph 6.2. of this appendix, the test vehicle is driven over a Type I test (Parts One and Two).

Except as provided below in 6.4.3, the MI shall be activated at the latest before the end of this test under any of the conditions given in paragraphs 6.4.1.2. to 6.4.1.5. of this appendix. The MI may also be activated during preconditioning. The Technical Service may substitute those conditions with others in accordance with paragraph 6.4.1.6. of this appendix. However, the total number of failures simulated shall not exceed four (4) for the purpose of type approval.

In the case of testing a bi-fuel gas vehicle, both fuel types shall be used within the maximum of four (4) simulated failures at the discretion of the Type Approval Authority.

6.4.1.2 Replacement of a catalyst with a deteriorated or defective catalyst or electronic simulation of a deteriorated or defective catalyst that results in emissions exceeding the NMHC limit given in paragraph 3.3.2. of this annex.

6.4.1.3. An induced misfire condition according to the conditions for misfire monitoring given in paragraph 3.3.3.2. of this annex that results in emissions exceeding any of the limits given in paragraph 3.3.2. of this annex.

6.4.1.4. Replacement of an oxygen sensor with a deteriorated or defective oxygen sensor or electronic simulation of a deteriorated or defective oxygen sensor that results in emissions exceeding any of the limits given in paragraph 3.3.2. of this annex.

6.4.1.5. Electrical disconnection of the electronic evaporative purge control device (if equipped and if active on the selected fuel type).

6.4.1.6. Electrical disconnection of any other emission-related power-train component connected to a computer that results in emissions exceeding any of the limits given in paragraph 3.3.2. of this annex (if active on the selected fuel type).

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6.4 OBD system test

6.4.2. Vehicles fitted with compression-ignition engines:

6.4.2.1. After vehicle preconditioning according to paragraph 6.2. of this appendix, the test vehicle is driven over a Type I test (Parts One and Two).

Except as provided for below in 6.4.3, the MI shall be activated at the latest before the end of this test under any of the conditions given in paragraphs 6.4.2.2. to 6.4.2.5 of this appendix. The MI may also be activated during preconditioning. The technical service may substitute those conditions by others in accordance with paragraph 6.4.2.5. of this appendix. However, the total number of failures simulated shall not exceed four (4) for the purposes of type approval.

6.4.2.2. Where fitted, replacement of a catalyst with a deteriorated or defective catalyst or electronic simulation of a deteriorated or defective catalyst that results in emissions exceeding limits given in paragraph 3.3.2. of this annex.

6.4.2.3. Where fitted, total removal of the particulate trap or replacement of the particulate trap with a defective particulate trap meeting the conditions of paragraph 6.3.2.2. of this appendix that results in emissions exceeding the limits given in paragraph 3.3.2. of this annex.

6.4.2.4. With reference to paragraph 6.3.2.5. of this appendix, disconnection of any fueling system electronic fuel quantity and timing actuator that results in emissions exceeding any of the limits given in paragraph 3.3.2. of this annex.

6.4.2.5. With reference to paragraph 6.3.2.5. of this appendix, disconnection of any other emission-related power-train component connected to a computer that results in emissions exceeding any of the limits given in paragraph 3.3.2. of this annex.

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Revised after f2f meeting on 30.09.&01.10.2019

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6.4 OBD system test

6.4.3. If the MI first illuminates after emissions exceed the applicable limit(s) of paragraph 3.3.2. by more than 20 per cent, the test vehicle shall be retested with the tested system or component adjusted so that the MI will illuminate without emissions exceeding the applicable limit(s) of paragraph 3.3.2. by more than 20 per cent.

If the system or component cannot be adjusted to meet this criterion because a default mode is used when a malfunction is detected (e.g., open loop fuel control used after an O2 sensor malfunction is determined, etc.), the manufacturer may request the Technical Service to retest the test vehicle with the system or component adjusted to the worst acceptable limit (i.e., the applicable monitor indicates the system or component's performance is passing but at the closest possible value relative to the monitor threshold value at which a fault would be detected that would invoke the default mode and illuminate the MI). The Technical Service shall may approve the request upon determining that the manufacturer has submitted data and/or engineering evaluation that describe the default mode incl. its technical necessity. The manufacturer may request the Technical Service to accept this additional test data when the system or component's performance is at the worst acceptable limit within a margin of error necessary to accommodate testing variability and/or other practical limitations in setting the performance at the absolute worst acceptable limit. The Technical Service shall may accept the this additional test data upon determining that the test data adequately demonstrate that emissions do not exceed the applicable limit(s) of paragraph 3.3.2. by more than 20 per cent at the tested worst acceptable limit and that emissions will not exceed the applicable limit(s) of paragraph 3.3.2. by more than 20 per cent before performance exceeds the monitor threshold for fault detection. With respect to performing the OBD system test over the Type I test, two sets of test data are necessary for the approval by the Technical Service: a) original test data with malfunction detection and MI illumination and emissions exceeding the applicable limit(s) of paragraph 3.3.2. by more than 20 per cent due to default mode activation, and b) additional test data without malfunction detection and without MI illumination and without emissions exceeding the applicable limit(s) of paragraph 3.3.2. by more than 20 per cent due to no default mode activation.

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Added after f2f meeting on 30.09.&01.10.2019

ANNEX 11 - APPENDIX 1

1. Introduction

This appendix describes the procedure of the test according to paragraph 3. of this annex. The procedure describes a method for checking the function of the On-Board Diagnostic (OBD) system installed on the vehicle by failure simulation of relevant systems in the engine management or emission control system. It also sets procedures for determining the durability of OBD systems.

The manufacturer shall make available the defective components and/or electrical devices which would be used to simulate failures. When measured over the Type I test cycle, such defective components or devices shall not cause the vehicle emissions to exceed the limits of paragraph 3.3.2. by more than 20 per cent. For electrical failures (short/open circuit), the emissions may exceed the limits of paragraph 3.3.2. by more than twenty per cent.

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

For default mode activation after malfunction detection, the OBD system can be approved according to the specific requirements under 6.4.3.