Submitted by the IWG on EPPR

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Agenda item 8(b)

Proposal for Amendments to GRPE/~~2019~~2020/17

Proposal for Amendment 1 to UN GTR No. 18 (Global technical regulation on the measurement procedure for two- or three-wheeled motor vehicles with regard to on-board diagnostics)

Submitted by the Informal Working Group on Environmental and Propulsion Performance Requirements (EPPR)*

The text reproduced below was submitted by the Informal Working Group (IWG) on Environmental and Propulsion Performance Requirements of L-category vehicles (EPPR) in order to provide amendments to GRPE/~~2019~~2020/17, the draft proposal for amendments to UN GTR 18 in order to include OBD2.

GRPE/~~2019~~2020/17is the consolidated document addressing the phase 1 and 2 of the work of the IWG, as agreed at the 34th EPPR session of March 2020.

The current draft informal document contains all changes agreed up to the 36th EPPR session of June 2020. It is presented in a consolidated version deemed to supersede GRPE/~~2019~~2020/17.

Contents

* In accordance with the programme of work of the Inland Transport Committee for 2018–2019 (ECE/TRANS/274, para. 123 and ECE/TRANS/2018/21 and Add.1, Cluster 3), 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. Statement of technical rationale and justification

A. Introduction

1. The industry producing two- and three-wheeled vehicles in the scope of this global technical regulation (gtr) is a global one, with companies selling their products in many different countries. The Contracting Parties to the 1998 Agreement have determined that work should be undertaken to address the environmental and propulsion unit performance requirements of two- and three-wheeled light motor vehicles, among others as a way to help improve air quality internationally. Currently, the gtr is directed at harmonizing On-Board Diagnostic requirements (OBD) for two- and three-wheeled vehicles, similar as targeted with gtr No. 5 for heavy duty vehicles. This common set of agreed rules in the area of OBD allows the Contracting Parties to realize their own domestic objectives and to pursue their own levels of priorities. Nonetheless, as discussed in more detail below, the gtr has been structured in a manner that facilitates a wider application of OBD to other vehicle systems and objectives in the future.

2. This gtr establishes harmonized functional requirements for OBD and a procedure to test and verify the environmental OBD functions (test type VIII). The functional requirements and test procedures were developed so that they would be able to provide an internationally harmonized set of functional OBD requirements with respect to the "infra-structure" on-board of a vehicle in the scope of this UN GTR, which determines hardware and software design in a technology neutral way and that considers technical feasibility and cost-effectiveness.

3. This UN GTR also covers harmonized requirements to conduct the environmental verification test procedure (test type VIII) relating to OBD, which is a test procedure by simulating a failure of an emission relevant component in the powertrain management system and its emission control system. Subsequently the OBD system reaction and containment of the failure is monitored and reported during type I test tailpipe emission verification tests.

4. OBD should not oblige manufacturers to change or add fuelling or ignition hardware and should not impose fitting of an electronic carburettor, electronic fuel injection or electronically controlled ignition coils, providing

the vehicle complies with the applicable environmental performance requirements. Compliance with the OBD requirements implies that if fuel delivery, spark delivery or intake air hardware is electronically controlled, the applicable input or output circuits need to be monitored, limited to the items and failure modes listed in Table A2/1 of Annex 2.

5. This UN GTR is based on the work of the Informal Working Group (IWG) on Environmental and Propulsion unit Performance Requirements (EPPR) of vehicles, from now on referred to as EPPR IWG, which held its first meeting during the sixty-fifth GRPE in January 2013 and on the initial proposal by the European Union (EU, represented by the European Commission (EC)).

B. Procedural background and future development of the gtr

6. The EU put forward and announced their intention of setting up a working group during the sixty-third and sixty-fourth sessions of the Working Party on Pollution and Energy (GRPE) in January and June 2012, and at the 157th session of the World Forum for Harmonization of Vehicle Regulations (WP.29) in June 2012.

7. WP.29 endorsed the proposal (WP.29-158-15) to establish the EPPR IWG under GRPE at its 158th session (13-16th November 2012). The official mandate document is available on the UNECE website with the symbol ECE/TRANS/WP.29/AC.3/36. As this mandate ended by January 2016, the IWG submitted a request to extend the mandate until the end of 2020 (ECE/TRANS/WP.29/2015/113). The Executive Committee of the 1998 Agreement (AC.3) adopted this extension of the mandate at its November 2015 session, which is referred to as ECE/TRANS/WP.29/AC.3/36/Rev.1.

8. At the seventy-six GRPE session in January 2018, a proposal of this amendment to UN GTR 18 was tabled for adoption.

9. Ongoing developments of test types and procedures and global discussion on harmonization have resulted in the technical requirements contained within this amendment. The final text of the Amendment 1 to UN GTR18 is presented in section II of this document.

C. Existing regulations, directives and international voluntary standards

1. Technical references in the development of the gtr

10. For the development of the gtr, the following legislation and technical standards contain relevant applications of requirements for motorcycles and other vehicles in the scope of this gtr or transferable provisions for passenger cars:

(a) UN (1958 Agreement, light-duty legislation): Chapter 11 of Regulation No. 83;

(b) UN (1998 Agreement, heavy-duty legislation): gtr No. 5;

(c) UN Mutual Resolution No. 2 (M.R.2);

(d) EU: Annex XII to Regulation (EU) No. 44/2014 (Delegated Act on Vehicle Construction Requirements supplementing Regulation (EU) No. 168/2013) with respect to functional OBD requirements, Annex VIII of Regulation (EU) No. 134/2014 (Delegated Act on Environmental and Propulsion Unit Performance supplementing Regulation (EU) No. 168/2013) and Article 21 of Regulation (EU) No. 168/2013;

(e) Japan: Safety Regulations for Road Vehicles, Article 31, Attachment 115;

(f) The United States of America (light-duty legislation): US CFR, Title 40, Part 86, Subpart S;

(g) Standards:

(i) International: ISO 2575, ISO 9141-2, ISO 14229-3, ISO 14229-4, ISO 14230-4, ISO 15031-4, ISO 15031-5, ISO 15031-6, ISO 15765-4, ISO 20828, ISO 22901-2;

(ii) USA: SAE J1850.

2. Methodology for deriving harmonized test procedures for the gtr

11. The European Commission launched an EPPR study for L-category vehicles in January 2012 with the objective to develop proposals to update UN GTR No. 2 for technical progress and to develop proposals for UN GTRs and Regulations with respect to harmonized EPPR legislation not yet covered at the international level for two- and three-wheeled vehicles, e.g. crankcase and evaporative emission test requirements, on-board diagnostic requirements, propulsion unit performance requirements, etc. The output of this comprehensive study[1] was submitted for the review and comments of the EPPR IWG with the objective to identify concerns and to provide base proposals ready for further enhancements by the EPPR IWG in order to accommodate the needs at the international level to assess a vehicle with respect to on-board diagnostics in a scientifically based, objective and globally accepted way.

12. The outcome of this work was among others the development of the UN GTR 18 on OBD based on the EC regulation. Based on the same EC regulation the first draft of the amendment to UN GTR 18 to include OBD II

[1] Document reference EPPR-07- 07

was drawn. This text then further evolved in many different revisions and was modified in iterative steps to reflect the discussions and decisions by the Group over the period 2018 - 2020.

13. Because the need of one of the Contracting Parties, the work was divided into two phases in order to provide the basis of the national regulation on areas of urgency, leaving for the second phase the rest of the areas to be addressed in the amendment. The work of phase one was concluded in March 2019 (GRPE-79-23).

D. Discussion of the issues addressed by the UN GTR

1. List of issues

14. This UN GTR brings together the harmonized test procedures with regard to on-board diagnostic requirements for the approval of vehicles in the scope of this UN GTR. The process to develop this UN GTR followed the methodology discussed in chapter C.2, where important issues discussed and addressed during the development were, among others:

a) Access to OBD; in particular access to vehicle security features

b) Catalytic converter monitoring

c) Environmental performance related functions and functional safety ('limp-home' operating mode which significantly reduces engine torque).

d) Introduction by the Contracting Parties of OTL 2 and OTL 1.

15. The above issues have been resolved in a climate of cooperation and good will to find a solution that meet the needs of all the parties:

a) Access to vehicle security features: This issue has been addressed and resolved by introducing security technology that ensures confidentiality, integrity and protection against replay.

b) Catalytic converter monitoring: the difficulty arose because the European Commission study (see paragraph 11) indicated that the introduction of catalytic converter monitoring via OBD provided a cost beneficial (CBA) procedure to control possible tampering with the exhaust system of the vehicle specially for positive ignition engines systems. A study presented by IMMA on countries from other regions of the world indicated that in those regions the CBA for the introduction of catalytic monitoring via OBD was negative. The EC could not accept that the OBD would not continuously monitor the catalytic converter deterioration as fight against exhaust system tampering was very high in the EC agenda. Other Contracting Parties were also in agreement that anti-tampering of the exhaust system is

a must and therefore although not wanting to have a catalytic converter monitoring via OBD, they would like to see wordings that allow for other approaches. After several reiteration, a common proposal by Japan and the EC was agreed by introduction the catalytic monitoring as a Contracting Party option under the conditions provided in paragraph 5.3.4 and 5.3.5 of the general requirements. This prescription also allows the contracting party to impose alternative methods for controlling the tampering with the exhaust system (catalytic converter). However, it is understood that a Contracting Party may only choose to prescribe other conditions that the exhaust system needs to satisfy (paragraph 5.3.4.2 and 5.3.5.2) if paragraph 5.3.4.1 or 5.3.5.1 are not satisfied by the manufacturer.

c) OBD and functional safety: Some Contracting Parties are not yet in the position to introduce in their regulation functional safety via OBD. Therefore, a separation between environmental performance related OBD functions and functional safety related OBD was agreed. This will allow the different Contracting Parties to introduce only environmental performance related OBD functions or both.

d) The option of go directly to OTL 2 without first passing by OTL 1 was allowed in order to meet the requirements of some Contracting Parties that would like to apply OTL 2 directly without applying first for a given peridot OTL 1.

2. Applicability

16. The EPPR IWG, as agreed upon in the terms of reference, has prepared a UN GTR for vehicles in the scope of this UN GTR under the 1998 Agreement as well as two- or three-wheeled vehicles under the 1958 Agreement. In accordance with the agreed terms of reference, UN GTRs and Regulations in the area of EPPR will be developed as much as possible in a coherent way.

3. Scope

17. The EPPR IWG has discussed at length which vehicle types should be in the scope of the UN GTR. One of the objectives of the Group was to discuss the substantive requirements of two-wheeled vehicles first followed by a discussion if these requirements should as well be applied to three-wheeled vehicles. In particular it was debated whether or not the classification criteria laid down in paragraph 2. of Special Resolution No. 1 (S.R.1) on category 3 vehicles should be referenced in detail or using a more generic wording, e.g. two- and three-wheeled vehicles or motorcycles allowing for more flexibility to allow alignment with domestic classification of three-wheeled vehicles.

18. The EPPR IWG discussed possible solutions how three-wheeled vehicles could be included in the scope of the UN GTR given the fact that S.R.1 contains recommended classification criteria for category 3 vehicles that might require an update for technical progress. Finally, it was agreed to put "category 3" vehicles in paragraph 2. of the UN GTR and to reference S.R.1 in a footnote.

19. Contracting Parties may expand the scope to other types of three-wheeled vehicles in order to align with their domestic classifications of three-wheeled vehicles as deemed appropriate.

4. Definitions

21. The definitions used in the UN GTR are aligned as much as possible with definitions in international legislation and from the work of the Vehicle Propulsion System Definitions (VPSD) Group operating under GRPE with the goal to harmonize high level powertrain definitions as well as from other regional legislation as listed in chapter C.1. The definitions set out in Mutual Resolution No. 2 were re-used where possible in this UN GTR.

22. In the definition of "useful life" a reference to a period of time has been included, because of the following reasons:

(a) Firstly, the general life cycle for industrial products is prescribed by its life period, so the time is the necessary parameter to define the life cycle. For instance, if a vehicle with the product warranty for "ten years and total mileage of one-hundred-thousand kilometres" has only one kilometre as total mileage but is 20-years old, the vehicle should not be regarded as in-warranty.

(b) Secondly, the definition in the UN GTR on crankcase and evaporative emissions is also referring to the period of distance and time.

5. Requirements

23. Regarding functional requirements for OBD, the UN GTR contains the following main items:

(a) Minimum monitoring requirements for OBD stage I;

(b) Provisions regarding design of the Malfunction Indicator (MI), diagnostic trouble codes, diagnostic signals and connection interfaces;

(c) Provisions regarding access to OBD information;

(d) Definition of propulsion unit families with regard to OBD.

24. Regarding the environmental test procedure for OBD, the UN GTR contains the elements:

(a) Test vehicle requirements;

(b) Test procedure by simulating failure of exhaust emission relevant components in the powertrain management system and emission control system and monitoring the OBD system reaction during a type I test cycle;

(c) Failure modes to be tested for OBD.

25. Minimum administrative requirements have been set out to reflect the technical requirements addressed in this UN GTR.

6. Reference fuel

27. The reference fuel shall be specified and selected by the Contracting Parties as deemed appropriate and is not harmonized yet. However, it is strongly recommended to use the same test fuel specification for type VIII environmental OBD verification testing as was used for type I tailpipe emissions after cold start testing and for tailpipe emissions verification testing as part of test type V durability of pollution control devices.

7. Regulatory impact and economic effectiveness

28. Increasingly two- and three-wheeled vehicles in the scope of this UN GTR are being designed for the world market. To the extent that manufacturers are preparing substantially different models in order to meet different emission regulations and methods of measuring CO_2 emission and fuel or energy consumption, testing costs and other production values are increased. It would be more economically efficient to have manufacturers use a similar test procedure worldwide wherever possible to prove satisfactory performance before being placed on the market. A prerequisite for that is a harmonized definition of the test procedures with respect to on-board diagnostics. It is anticipated that the test procedures in this UN GTR will provide a common test programme for manufacturers to use in countries worldwide and thus reduce the amount of resources utilised to test vehicles in the scope of this UN GTR. These savings will accrue not only to the manufacturers, but more importantly, to the consumers and the authorities as well.

8. Potential cost effectiveness

29. At the time of writing this revision of the UN GTR, the data is not available to undertake a full impact assessment of the test procedures contained. Specific cost effectiveness values in markets around the globe can be quite different, depending on the national or regional market situation. While there are no calculated values here, the belief of the EPPR

IWG is that there are clear and significant benefits comparing to low anticipated cost increases associated with this UN GTR (see paragraph 15 b)).

II. Text of the global technical regulation

1. Purpose

1.1. This UN GTR prescribes the requirements for On-Board Diagnostic (OBD) systems to detect, record and/or communicate failures of specific vehicle and engine systems that affect the environmental performance of these systems, as described in the specific annexes to this UN GTR.

1.2. In addition, this UN GTR specifies the elements concerning the OBD system to facilitate the diagnosis, efficient and effective repair and maintenance of specific vehicle and engine systems without containing mandatory prescriptions for this purpose.

1.3. OBD should not oblige manufacturers to change or add fuelling or ignition hardware and should not impose fitting of an electronic carburettor, electronic fuel injection or electronically controlled ignition coils, providing the vehicle complies with the applicable environmental performance requirements. Compliance with the OBD requirements implies that if fuel delivery, spark delivery or intake air hardware is electronically controlled, the applicable input or output circuits need to be monitored, limited to the items and failure modes listed in ~~Table 1 of Annex 2~~Table A2/1 of Annex 2.

2. Scope and application

Two- and three-wheeled vehicles of category 3* equipped with a propulsion unit in accordance with Table 1.

*ECE/TRANS/WP.29/1045, as amended by Amends. 1 and 2 (Special Resolution No. 1).

Table 1: Scope with regard to the propulsion unit and fuel type

Propulsion unit and fuel type			*Functional OBD*	*Test type VIII*
Vehicle with PI engine	Mono-fuel	Petrol	Yes	Yes
Vehicle with CI engine	Mono-fuel	Diesel	Yes	Yes

3. Definitions

The definitions set out in UN GTR No. 2 shall apply. In addition, the following definitions shall apply in this UN GTR:

3.1. "Access" means the availability of all emission-related OBD data including all fault codes required for the inspection, diagnosis, servicing or repair of emissions-related parts of the vehicle, via the serial interface for the standard diagnostic connection pursuant to paragraph 3.12. of Annex 1.

3.2. *"Calibration verification number (CVN)"* means the number that is calculated and reported by the ECU/PCU to validate the calibration / software integrity.

3.3. "*Confirmed fault code (Confirmed DTC)*" is a diagnostic trouble code stored when an OBD system has confirmed that a malfunction exists.

3.4. "*Default mode*" refers to a case where the engine management controller switches to a setting that does not require an input from a failed component or system.

3.5. "*Deficiency*" means, in respect of vehicle OBD systems, that components or systems that are monitored contain temporary or permanent operating characteristics that impair the otherwise efficient OBD monitoring of those components or systems or do not meet all of the other detailed requirements for OBD.

3.6. *"Diagnostic trouble code (DTC)"* or *"fault code"* is a numeric or alphanumeric identifier for a fault condition identified by the On Board Diagnostic system.

3.7. *"Driving cycle"* consists of engine key-on, a driving mode where a malfunction would be detected if present, and engine key-off."

3.8. "*Emission control system*" means the electronic engine management controller and any emission related component in the exhaust or evaporative system which supplies an input to or receives an output from this controller.

3.9. *"Engine key-on/off"* means providing/interrupting electrical power to the electric circuit, sensors, actuators and electronic controllers. It is also referred to as power on/off or ignition on/off.

3.10. *"Engine misfire"* means lack of combustion in the cylinder(s) of a positive ignition engine due to absence of spark, poor fuel metering, poor compression or any other cause.

3.11. *"Fuel trim"* refers to feedback adjustments to the base fuel schedule. Short-term fuel trim refers to dynamic or instantaneous adjustments. Long-term fuel trim refers to much more gradual adjustments to the fuel calibration schedule than short-term trim adjustments. These long-term adjustments compensate for vehicle differences and gradual changes that occur over time.

3.12. *"Generic scan tool"* means an external test equipment used for standardized off-board communication with the OBD system in accordance with the requirements of this UN GTR.

3.13. A "*key cycle*" consists of engine key-on, engine cranking and idling where a malfunction would be detected if present, followed by engine key-off.

3.14. "*Limp-home*" means an operation mode triggered by the control system that restricts fuel quantity, intake air quantity, spark delivery or other powertrain

control variables resulting in significant reduction of output torque under default mode.

3.15. *"Malfunction Indicator (MI)" for category 3 vehicle** means a visible indicator that clearly informs the driver of the vehicle in the event of malfunction(s).

3.16. *"Malfunction" for category 3 vehicle** means the failure of a component or system that would result in emissions exceeding the OBD threshold limits (OTL) set out in paragraph 5.5.1. of general requirements, the circuit failure or the OBD system being unable to fulfil the basic monitoring requirements;

A Contracting Party may require triggering of Limp-home as the definition of "malfunction for category 3 vehicle*".

3.17. *"On-Board Diagnostic(OBD) system" for category 3 vehicle** means an electronic system fitted on-board of a vehicle that has the capability of identifying the likely area of malfunction by means of fault codes stored in a computer memory which can be accessed by means of a generic scan tool.

3.18. "*Pending fault code*" is a diagnostic trouble code stored upon the initial detection of a malfunction prior to illumination of the malfunction indicator.

3.19. "*Permanent emission default mode*" refers to a case where the engine management controller permanently switches to a setting that does not require an input from a failed component or system where such a failed component or system would result in increasing emissions from the vehicle exceeding the OBD threshold limits set out in this UN GTR.

3.20. "*Power take-off unit*" means an engine-driven output provision for the purposes of powering auxiliary, vehicle‑mounted equipment.

3.21. "*Repair information*" means all information required for diagnosis, servicing, inspection, periodic monitoring or repair of the vehicle and which the manufacturers provide for their authorized dealers/repair shops or for manufacturers of replacement or retrofit components which are compatible with the vehicle OBD system. Where necessary, such information shall include service handbooks, technical manuals, diagnosis information (e.g. minimum and maximum theoretical values for measurements), wiring diagrams, the software calibration identification number applicable to a vehicle type, instructions for individual and special cases, information provided concerning tools and equipment, data record information and bi-directional monitoring and test data as specified in paragraph 3.8. of Annex 1. The manufacturer shall also make accessible, where appropriate on 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 shall not be withheld improperly.

3.22. *"Readiness"* means a status indicating whether a monitor or a group of monitors for which status reporting is required according to this UN GTR have run since the fault memory was last cleared.

3.23. *"Secondary air"* refers to air introduced into the exhaust system by means of a pump or aspirator valve or other means that is intended to aid in the oxidation of HC and CO contained in the exhaust gas stream.

3.24. *"Significant reduction of propulsion torque"* means a propulsion torque less than or equal to 90 % of torque in normal operation mode.

3.25. *"Software calibration identification (CAL ID)"* means a series of alphanumeric characters that identify the emission-related calibration and/or software version.

3.26. *"Standardized"* means that all data stream information, including all fault codes used, shall be produced only in accordance with industry standards which, by virtue of the fact that their format and their permitted options are clearly defined, provided for a maximum level of harmonization in the motor vehicle industry, and whose use is explicitly permitted in this regulation.

3.27. "*Unrestricted access to the OBD information*" means:

(a) Access not dependent on an access code obtainable only from the manufacturer, or a similar device; or

(b) Access allowing evaluation of the data produced without the need for any unique decoding information, unless that information itself is standardized.

3.28. "*Useful life*" means the relevant period of distance and/or time over which compliance with the OBD system has to be assured.

3.29. *"Vehicle type"* means a category of power-driven vehicles which do not differ in essential engine/vehicle and OBD system characteristics.

3.30. *"Warm-up cycle" for category 3 vehicle** means sufficient vehicle operation such that the coolant temperature rises by at least 22 ºC from engine start-up to at least 70°C If this condition is insufficient to determine the warm up cycle, with the permission of the approval authority, alternative criteria and/or alternative signal(s) or information (e.g. spark plug seat temperature, engine oil temperature, vehicle operation time, accumulative engine revolution, travel distance, etc.) may be adopted. In any case, all signal(s) and information used for determination need to be monitored by the ECU and shall be made available by data stream.

4. List of acronyms and symbols

Commented [DL1]: Unit of measurement corrected, As agreed at EPPR-35 OBD2CG-18-02 (IMMA)

Item	*Unit*	*Term*
APS	-	accelerator (pedal / handle) position sensor
CAN	-	controller area network
CARB	-	California air resources board
CI	-	compression ignition engine
CO	mg/km	carbon monoxide
CO_2	mg/km	carbon dioxide
CVN		calibration verification number
deNOx		nitric oxide reduction system

Item	*Unit*	*Term*
DF		deterioration factors
DTC		diagnostic trouble code
ECU	-	engine control unit
EGR		exhaust gas recirculation system
EPA	-	United States Environmental Protection Agency
ETC	-	electronic throttle control
HC	mg/km	hydrocarbons
ID	-	identifier
ISO	-	international standardisation organisation
IUPR		in-use performance ratio
$IUPR_M$		in-use performance ratio of a specific monitor
KAM		keep alive memory
MI	-	malfunction indicator
NMHC	mg/km	non-methane hydrocarbon
NOx	mg/km	nitrogen oxides
OBD		on-board diagnosis
ODX	-	open diagnostic data exchange
OTL		OBD threshold limits
PCU	-	powertrain control unit
PI	-	positive ignition engine
PID	-	parameter identifier
PM	mg/km	particulate mass
PTO		power take-off unit
SAE	-	Society of Automotive Engineers
THC	mg/km	total hydrocarbon

Item	*Unit*	*Term*
TPS	-	throttle (accelerator actuator) position sensor
UDS	-	unified diagnostic services
VIN	-	vehicle identification number
VVT		variable valve timing
WMTC		world-harmonised motorcycle test cycle

5. General requirements

5.1. Vehicles, systems, and components shall be so designed, constructed and assembled by the manufacturer, so as to enable the vehicle, in normal use and maintained according to the prescriptions of the manufacturer, to comply with the provisions of this UN GTR during its useful life.

5.2. OBD system

5.2.1. The technical requirements of this section shall be mandatory for vehicles in the scope of this UN GTR equipped with the OBD systems.

5.3. Functional OBD requirements

5.3.1. OBD monitoring

a) The OBD system shall monitor and report any electric circuit and electronics failure of the emission control system, which is triggered when the OBD threshold limits as laid down in paragraph 5.5.1. are being exceeded. Also, the OBD system shall monitor and report emission control system failures and degradations which result in the OBD threshold limits being exceeded.

b) In addition, a Contracting Party may require that the OBD system shall monitor and report any electric circuit and electronics failure of the emission control system, which may result in any operating mode leading to the significantly reduced engine propulsion torque.

5.3.2 Vehicles in the scope of this UN GTR shall be equipped with an OBD system so designed, constructed and installed in a vehicle as to continue monitoring to identify types of deterioration or malfunction over the entire life of the vehicle. In achieving this objective, vehicles which have travelled distances in excess of the distance specified in durability test by the contracting party may show some deterioration in OBD system performance such that the OBD threshold limits given in paragraph 5.5.1. may be exceeded before the OBD system signals a failure to the driver of the vehicle.

5.3.2.1. Access to the OBD system required for the inspection, diagnosis, servicing or repair of the vehicle shall be unrestricted and standardised. All OBD relevant diagnostic trouble codes shall be consistent with paragraph 3.11. of Annex 1.

5.3.2.2. At the manufacturer’s discretion, to aid technicians in the efficient repair of vehicles, the OBD system may be extended to monitor and report on any other

on-board system. Extended diagnostic systems shall not be considered as falling under the scope of approval requirements.

5.3.3. Monitoring requirements of electric circuit and electronics failure

For the purposes of paragraph 5.3.1., 5.3.7. and 5.3.8, the electric circuit and electronic failure diagnostics with regard to OBD shall at a minimum contain the sensor and actuator diagnostics as well as the internal diagnostics of the electronic control units required in ~~Table 1 of Annex 2~~Table A2/1 of Annex 2.

5.3.4. Monitoring requirements for vehicles equipped with positive-ignition engines

The OBD system shall indicate the failure of an emission-related component or system when that failure results in emissions exceeding the OBD threshold limits referred to in paragraph 5.5.1. In satisfying the requirements of paragraph 5.3.1., the OBD system shall, at a minimum, monitor for:

~~[~~5.3.4.1. Catalytic converter deterioration and performance

The reduction in the efficiency of the catalytic converter with respect to emissions of hydrocarbons and nitrogen oxides shall be monitored. Manufacturers may monitor the front catalyst alone or in combination with the next catalyst(s) downstream. Each monitored catalyst or catalyst combination shall be considered to be malfunctioning if the emissions exceed the NMHC~~/THC~~ or NOx thresholds ~~provided for~~ identified in paragraph 5.5.1.~~]~~

5.3.4.2. Notwithstanding paragraph 5.3.4.1., a Contracting Party may choose not to require the monitoring of the catalytic converter.

(a) A Contracting Party not requiring the monitoring of the catalytic converter may prescribe other conditions that the exhaust system needs to satisfy.

(b) A Contracting Party may apply paragraph 5.3.4.2. to limited vehicle class(es).

5.3.4.~~2~~3. Engine misfire

The presence of engine misfire in the engine operating region bounded by the following lines:

(a) low speed limit: A minimum speed of 2 500 min -1 or normal idle speed +1000 min -1, whichever is the lower

(b) high speed limit: A maximum speed of 8 000 min -1 or 1000 min-1 greater than the highest speed occurring during a type I test cycle or maximum design engine speed minus 500 min-1, whichever is lower

(c) a line joining the following engine operating points:

(i) a point on the low speed limit defined in (a) with the absolute value of engine intake pressure at 3.3 kPa higher than the absolute value of pressure at the positive torque line;

(ii) a point on the high speed limit defined in (b) with the absolute value of engine intake pressure at 13.3 kPa higher than the absolute value of pressure at the positive torque line.

The engine operation region for misfire detection is reflected in ~~[~~Figure 1~~]~~.

Commented [DL2]: As agreed at EPPR-36; see OBD2CG-19-05

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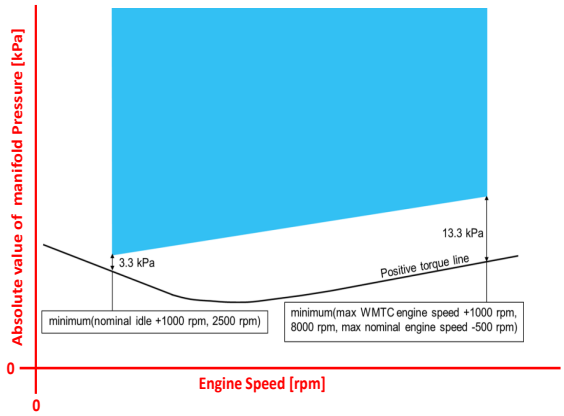

[Figure 1] Operating region for misfire detection

5.3.4.~~3~~4. Oxygen sensor deterioration

This paragraph shall mean that the deterioration of all oxygen sensors fitted and used for monitoring malfunctions of the catalytic converter in accordance with the requirements of this section shall be monitored.

5.3.4.~~4~~5. The electronic evaporative emission purge control shall, at a minimum, be monitored for circuit continuity.

5.3.4.~~5~~6. For direct injection positive ignition engines, any malfunction that could lead to emissions exceeding the particulate mass (PM) OBD threshold limits provided in paragraph 5.5.1. shall be monitored in accordance with the requirements of this section for compression ignition engines.

5.3.5. Monitoring requirements for vehicles equipped with compression ignition engines

The OBD system shall indicate the failure of an emission-related component or system when that failure results in emissions exceeding the OBD threshold limits referred to in paragraph 5.5.1.

In satisfying the requirements of paragraph 5.3.1., the OBD system shall, at a minimum, monitor for:

[5.3.5.1. Catalytic converter deterioration and performance.

Reduction in the efficiency of the catalytic converter, where fitted;

5.3.5.2 Notwithstanding paragraph 5.3.5.1., a Contracting Party may choose not to require the monitoring of the catalytic converter].

5.3.5.~~2~~3. The functionality and integrity of the particulate trap, where fitted.

5.3.5.~~3~~4. The fuel-injection system electronic fuel quantity and timing actuator(s) is/are monitored for circuit continuity and total functional failure.

5.3.5.~~4~~5. Malfunctions and the reduction in efficiency of the EGR system, shall be monitored.

Commented [DL5]: Although we did not discuss at EPPR-36, it is suggested to set paragraph 5.3.5. similarly to the equivalent paragraph for positive ignition engines (5.3.4.).

Commented [DL6]: Original proposal in OBD2CG-19-05. However, although we did not discuss at EPPR-36, it is suggested to set paragraph 5.3.5. similarly to the equivalent paragraph for positive ignition engines (5.3.4.).

Commented [DL7R6]: EPPR 36 + wording correction on 2nd day

5.3.5.~~5~~6. Malfunctions and the reduction in efficiency of a NOx after-treatment system using a reagent and the reagent dosing subsystem shall be monitored.

5.3.5.~~6~~7. Malfunctions and the reduction in efficiency of NOx after-treatment not using a reagent shall be monitored.

5.3.6. If active, the emission control system components or systems, or emission-related powertrain components or systems, which are connected to a computer shall be monitored, the failure of which may result in tailpipe emissions exceeding the OBD threshold limits given in paragraph 5.5.1.

5.3.7. a) Unless otherwise monitored, any other electronic powertrain component connected to a computer relevant for environmental performance, including any relevant sensors to enable monitoring functions to be carried out, shall be monitored for electric/electronic circuit failures. In particular these electronic components shall be continuously monitored for any electric circuit continuity failure, shorted electric circuits, electric range/performance and stuck signal of the emissions control system.

b) A Contracting Party may require in addition that any other electronic powertrain component connected to a computer relevant for functional safety, including any relevant sensors to enable monitoring functions to be carried out, shall be monitored for electric/electronic circuit failures.

5.3.8. a) Unless otherwise monitored, for any other powertrain component connected to a computer relevant for the environmental performance, without prejudice to the ~~Table 1 of Annex 2~~Table A2/1 of Annex 2, the relevant diagnostic trouble code shall be stored.

b) A Contracting Party may require in addition that for any other powertrain component connected to a computer relevant for the functional safety and/or triggering of any programmed 'limp-home' operating mode which significantly reduces engine torque, e.g. to safeguard powertrain components, without prejudice to the ~~Table 1 of Annex 2~~Table A2/1 of Annex 2, the relevant diagnostic trouble code shall be stored.

5.3.9. Manufacturers may demonstrate to the approval authority that certain components or systems need not be monitored if, in the event of their total failure or removal, emissions do not exceed the OBD threshold limits given in paragraph 5.5.1.

5.3.10. A sequence of diagnostic checks shall be initiated at each engine start and completed at least once provided that the correct test conditions are met. The test conditions shall be selected in such a way that they all occur in the course of normal driving as represented by the type I test of UN GTR No.2. If the failure cannot be reliably detected under the type I test of UN GTR No.2 test conditions, the manufacturer may propose supplemental test conditions that do allow robust detection of the failure to be agreed with the technical service to the satisfaction of the approval authority.

Commented [DL8]: Editorial correction
As agreed at EPPR-35
OBD2CG-18-02 (IMMA)

5.3.11. The OBD system shall be so designed, constructed and installed in a vehicle as to enable it to comply with the requirements of this UN GTR during conditions of normal use.

5.3.11.1. Temporary disablement of the OBD system

5.3.11.1.1. A manufacturer may disable the OBD system if its ability to monitor is affected by low fuel levels or below the minimum state of charge of the electric system

batteries (maximum discharge of capacity). Disablement shall not occur when the fuel tank level is above 20 per cent of the nominal capacity of the fuel tank.

5.3.11.1.2. A manufacturer may disable the OBD system at ambient engine starting temperatures below 266.2 K (- 7 deg. C) or at elevations over 2440 metres above sea level or an ambient pressure of less than 75.7kPa, provided it submits data and/or an engineering evaluation which adequately demonstrate that monitoring would be unreliable in such conditions. It may also request disablement of the OBD system at other conditions if it demonstrates to the authority with data and/or an engineering evaluation that misdiagnosis would occur under such conditions. It is not necessary to illuminate the malfunction indicator (MI) if the OBD threshold limits are exceeded during regeneration, provided no defect is present.

5.3.11.1.3. For vehicles designed to accommodate the installation of power take-off units, disablement of affected monitoring systems is permitted provided disablement occurs only when the power take-off unit is active.

5.3.11.2. Engine misfire in vehicles equipped with positive-ignition engines.

5.3.11.2.1. Manufacturers may adopt higher misfire percentage malfunction criteria than those declared to the authority, under specific engine speed and load conditions where it can be demonstrated to the authority that the detection of lower levels of misfire would be unreliable. In terms of OBD monitoring, it is that percentage of misfires out of a total number of firing events (as declared by the manufacturer) that would result in emissions exceeding the OBD threshold limits set out in paragraph 5.5.1., or that percentage that could lead to an exhaust catalyst(s) overheating, causing irreversible damage.

5.3.11.2.2. When a manufacturer can demonstrate to the authority that the detection of higher levels of misfire percentages is still not feasible, or that misfire cannot be distinguished from other effects (e.g. rough roads, transmission shifts, after engine starting, etc.), the misfire monitoring system may be disabled when such conditions exist.

5.3.11.3. Identification of deterioration or malfunctions may also be done outside a driving cycle (e.g. after engine shutdown).

5.3.12. Activation of the Malfunction Indicator (MI)

5.3.12.1. The OBD system shall incorporate a malfunction indicator readily perceivable to the vehicle operator. The MI shall not be used for any purposes other than to indicate emergency start-up or limp-home routines to the driver. The MI shall be visible in all reasonable lighting conditions. When activated, it shall display a symbol in conformity with ISO 2575:2010, symbol F.01. A vehicle shall not be equipped with more than one general purpose MI for emission-related problems or powertrain faults leading to significantly reduced torque. Separate specific purpose tell-tales (e. g. brake system, fasten seat belt, oil pressure, etc.) are permitted. The use of red colour for an MI is prohibited.

5.3.12.2. For strategies requiring more than two preconditioning cycles for MI activation, the manufacturer shall provide data and/or an engineering evaluation which adequately demonstrate that the monitoring system is equally effective and timely in detecting component deterioration. Strategies requiring on average more than ten driving cycles for MI activation are not accepted.

a) The MI shall also activate whenever the powertrain control enters a permanent emission default mode of operation if the OBD threshold limits in

paragraph 5.5.1. are exceeded or if the OBD system is unable to fulfil the basic monitoring requirements laid down in paragraph 5.3.4 or 5.3.5.

b) A Contracting Party may require in addition that the MI shall activate whenever the powertrain control enters a limp home mode.

5.3.12.3. The MI shall operate in a distinct warning mode, e.g. a flashing light, during any period in which engine misfire occurs at a level likely to cause catalyst damage, as specified by the manufacturer.

5.3.12.4. The MI shall also activate when the vehicle's ignition is in the 'key on' position before engine starting or cranking and deactivate if no malfunction has been detected. For vehicles not equipped with a battery, the MI shall illuminate immediately after engine starting and shall subsequently be deactivated after 5 seconds, if no malfunction has previously been detected.

5.3.13. a) The OBD system shall record fault code(s) indicating the status of the emission control system or of the functional safety system leading to an operation mode with significantly reduced torque in comparison to normal operation mode. Separate status codes shall be used to identify correctly functioning emission control systems and those emission control systems which need further vehicle operation to be fully evaluated. If the MI is activated due to deterioration or malfunction or permanent emission default modes of operation, a fault code shall be stored that identifies the type of malfunction. A fault code shall also be stored in the cases referred to in paragraphs 5.3.7. and 5.3.8.

b) A Contracting Party may require ~~in addition~~ that the OBD system shall record only fault code(s) indicating the status of the emission control system. Separate status codes shall be used to identify correctly functioning emission control systems and those emission control systems which need further vehicle operation to be fully evaluated. If the MI is activated due to deterioration or malfunction or permanent emission default modes of operation, a fault code shall be stored that identifies the type of malfunction. A fault code shall also be stored in the cases referred to in paragraphs 5.3.7. and 5.3.8.

Commented [DL9]: Editorial correction

c) A contracting party may require the OBD system shall record only fault code(s) indicating the status of the emission control system leading to an operation mode with significantly reduced torque in comparison to normal operation mode. Separate status codes shall be used to identify correctly functioning emission control systems and those emission control systems which need further vehicle operation to be fully evaluated. If the MI is activated due to deterioration or malfunction or permanent emission default modes of operation, a fault code shall be stored that identifies the type of malfunction. The fault code shall also be stored in the cases referred to in paragraphs 5.3.7. a) and 5.3.8. a).

5.3.13.1. The distance travelled by the vehicle while the MI is activated shall be available at any moment through the serial port on the standardised diagnostic connector. By means of derogation for vehicles equipped with a mechanically operating odometer that does not allow input to the electronic control unit, "distance travelled" may be replaced with "engine operation time" and shall be made available at any moment through the serial port on the standardised diagnostic connector. Engine operation time in this context means the total accumulated time in which the propulsion unit(s) provide(s) mechanical output (e.g. the crankshaft of a combustion engine) and/or the engine is shut-down by the control system triggering the MI activation.

5.3.13.2. In the case of vehicles equipped with positive-ignition engines, misfiring cylinders need not be uniquely identified if a distinct single or multiple cylinder misfire fault code is stored.

5.3.13.3. The MI may be activated at levels of emissions below the OBD threshold limits set out in paragraph 5.5.1.

5.3.13.4. The MI may be activated if a default mode is active without significant reduction of propulsion torque.

5.3.14. Extinguishing the MI

5.3.14.1. If misfire at levels likely to cause catalyst damage (as specified by the manufacturer) is no longer taking place, or if the engine is operated after changes to speed and load conditions where the level of misfire will not cause catalyst damage, the MI may be switched back to the previous state of activation during the first driving cycle on which the misfire level was detected and to the normal activated mode on subsequent driving cycles. If the MI is switched back to the previous state of activation, the corresponding fault codes and stored freeze-frame conditions may be erased.

5.3.14.2. For all other malfunctions, the MI may be deactivated after three subsequent sequential driving cycles during which the monitoring system responsible for activating the MI ceases to detect the malfunction and if no other malfunction has been identified that would independently activate the MI.

5.3.15. Erasing a diagnostic trouble code

5.3.15.1. The OBD system may erase a diagnostic trouble code and the distance travelled and freeze-frame information if the same fault is not re-registered in at least 40 engine warm-up cycles.

5.3.15.2. Stored faults shall not be erased by disconnection of the on-board computer from the vehicle power supply or by disconnection or failure of the vehicle battery or batteries.

5.3.16 Additional provisions for vehicles employing engine shut - off strategies

5.3.16.1. Driving cycle

5.3.16.1.1. Autonomous engine restarts commanded by the engine control system following an engine stall may be considered a new driving cycle or a continuation of the existing driving cycle.

5.4. Requirements relating to the approval of on-board diagnostic systems

5.4.1. A manufacturer may ask the approval authority to accept an OBD system for approval even if the system contains one or more deficiencies so that the specific requirements of this annex are not fully met.

5.4.2. In considering the request, the authority shall determine whether compliance with the requirements of this annex is unfeasible or unreasonable.

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

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

5.4.2.2. The authority shall not accept any deficiency request that does not respect the OBD threshold limits in paragraph 5.5.1.

5.4.3. In the identified order of deficiencies, those relating to paragraph 5.3.4.1., 5.3.4.~~2~~3. and 5.3.4.~~3~~4. for positive-ignition engines and paragraph 5.3.5.1., 5.3.5.~~2~~3. and 5.3.5.~~3~~4. for compression-ignition engines shall be identified first.

Commented [DL10]:

Commented [DL11]:

5.4.4. Prior to, or at the time of, approval, no deficiency shall be granted in respect of the requirements of paragraph 3. of Annex 1, except paragraph 3.11. of Annex 1.

5.4.5. Deficiency period

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

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

5.4.6. The vehicle family criteria laid down in Table A7/1 of Annex 7 ~~(Table A7/1)~~ or vehicle parameters referred to Annex 5 with regard to test type VIII shall also be applicable for the functional on-board diagnostic requirements set out in this UN GTR.

5.5 OBD threshold limits

The requirements of OBD threshold limits are set out in paragraph 5.5.1.

5.5.1.

		Pollutant (mg/km)				
		CO	HC	NMHC	NOx	PM
OTL 1 Principal	PI Class 1/2	2170	1400	-	350	-
	PI Class 3	2170	630	-	450	-
	CI	2170	630	-	900	-
OTL 2 Enhanced	PI	1900	-	250	300	50
	CI	1900	-	320	540	50

5.5.2.

~~[~~Contracting Parties may either introduce OTL 2 directly or after the introduction of OTL 1.~~]~~

Commented [DL12]: As agreed at EPPR-36; see OBD2CG-19-05

5.6 Propulsion family definition with regard to OBD and in particular to test type VIII

5.6.1. A representative parent vehicle shall be selected to test and demonstrate to the approval authority the functional on-board diagnostic requirements set out in Annex 1 and to verify the test type VIII requirements laid down in Annex 6 based on the propulsion family definition laid down in Table A7/1 of Annex 7 ~~(Table A7/1)~~ or vehicle parameters referred to Annex 5. All members of the family shall comply with the applicable requirements and OBD threshold limits set out in this UN GTR.

5.7 Documentation

The vehicle manufacturer shall complete the information document in accordance with the items listed in Annex 8 and submit it to the approval authority.

5.8. Contracting Parties may implement IUPR requirements set out in this UN GTR. In case Contracting Parties implement IUPR requirements, they may either implement the requirements of $IUPR_M$ of greater than or equal to 0.1 directly or after the implementation of IUPR demonstration set out in this UN GTR.

5.9. Contracting Parties may introduce the requirements of access to OBD information set out in this UN GTR.

5.10. Notwithstanding 5.7., Contracting Parties may choose not to introduce the requirements of Administrative provisions set out in Annex 8 of this UN GTR.

Commented [DL13]: As agreed at EPPR-35 OBD2CG-18-02 (IMMA)

Annex 1

Functional aspects of On-Board Diagnostic (OBD) systems

1. Introduction

The on-board diagnostic systems fitted on vehicles in the scope of this UN GTR shall comply with the detailed information and functional requirements and verification test procedures of this annex in order to harmonize the systems and verify if the systems are capable of meeting the functional part of the on-board diagnostic requirements.

2. On-board diagnostic functional verification testing

2.1. The on-board diagnostic environmental system performance and the functional OBD capabilities may be verified and demonstrated to the approval authority by performing the type VIII test procedure referred to in Annex 6.

3. Diagnostic signals

3.1. Upon determination of the first malfunction of any component or system, "freeze-frame" engine conditions present at the time shall be stored in computer memory in accordance with the specifications in paragraph 3.10. Stored engine conditions shall include, but are not limited to, calculated load value, engine speed, fuel trim value(s) (if available), fuel pressure (if available), vehicle speed (if available), coolant temperature (if available), intake manifold pressure (if available), closed- or open-loop operation (if available) and the diagnostic trouble code which caused the data to be stored.

3.1.1. The manufacturer shall choose the most appropriate set of conditions facilitating effective and efficient repairs in freeze-frame storage. Only one frame of data is required. Manufacturers may choose to store additional frames provided that at least the required frame can be read by a generic scan tool meeting the specifications of paragraphs 3.9. If the diagnostic trouble code causing the conditions to be stored is erased in accordance with paragraph5.3.15. of general requirements, the stored engine conditions may also be erased.

3.1.2. Should a subsequent fuel system or misfire malfunction occur, any previously stored freeze-frame conditions shall be replaced by the fuel system or misfire conditions (whichever occurs first).

3.1.3. Calculated load value shall be calculated as to indicate percent of peak available torque during normal, fault-free conditions. In case of PI engines, calculated load value may be calculated as follows:

Equation 1:

$$CLV = \frac{Current\_airflow}{Peak\_airflow\ (at\_sea\_level)} \times \frac{Atmospheric\_pressure\_(at\_sea\_level)}{Barometric\_pressure}$$

$$CLV = \frac{Current\_airflow}{Peak\_airflow\ (at\_sea\_level)} \times \frac{Atmospheric\_pressure\_(at\_sea\_level)}{Barometric\_pressure}$$

Commented [DL14]: Equation re-formatted to make it editable

3.1.4. Alternatively, the manufacturer may choose another appropriate load variable of the propulsion unit (such as throttle position, intake manifold pressure, etc.) and shall demonstrate that the alternative load variable correlates well with calculated load variable set out in paragraph 3.1.3. and is in accordance with the specifications in paragraph 3.10.

3.2. If available, the following signals in addition to the required freeze-frame information shall be made available on demand through the serial port on the standardised diagnostic connector, if the information is available to the on-board computer or can be determined using information available to the on-board computer: diagnostic trouble codes, engine coolant temperature, fuel control system status (closed-loop, open-loop, other), fuel trim, ignition timing advance, intake air temperature, manifold air pressure, air flow rate, engine speed, throttle position sensor output value, secondary air status (upstream, downstream or atmosphere), calculated load value, vehicle speed and fuel pressure.

a) The signals shall be provided in standard units based on the specifications in paragraph 3.10. Actual signals shall be clearly identified separately from default value.

b) A Contracting Party may require in addition that actual signals shall be clearly identified separately from limp-home signals.

3.3. For all control systems for which specific on-board evaluation tests are conducted (catalyst, oxygen sensor, etc.) except, if applicable, misfire detection, fuel system monitoring and comprehensive component monitoring, the results of the most recent test performed by the vehicle and the limits to which the system is compared shall be made available through the serial data

port on the standardised diagnostic connector according to the specifications in paragraph 3.12. For the monitored components and systems excepted above, a pass/fail indication for the most recent test results shall be available through the standardised diagnostic connector.

All OBD in-use performance data that have to be stored under paragraph 4.6. shall be made available through the serial data port on the standardised diagnostic connector according to the specifications in paragraph 3.12.

3.4. The OBD requirements to which the vehicle is certified and the major control systems monitored by the OBD system in accordance with the specifications in paragraph 3.10. shall be made available through the serial data port on the standardised diagnostic data link connector according to the specifications in paragraph 3.8.

3.5. The software identification number (Cal ID) and calibration verification numbers (CVN) shall be made available through the serial port on the standardised diagnostic data link connector. Both numbers shall be provided in a standardised format in accordance with the specifications in paragraph 3.10.

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

3.7. The diagnostic system shall provide for standardised and unrestricted access to OBD and conform to the following ISO standards or SAE specification. Later versions may be used at the manufacturers' discretion.

3.8. One of the following standards with the restrictions described shall be used as the on-board to off-board communications link:

(a) ISO 9141-2:1994/Amd 1:1996: "Road Vehicles — Diagnostic Systems — Part 2: CARB requirements for interchange of digital information";

(b) SAE J1850: March 1998 "Class B Data Communication Network Interface. Emission related messages shall use the cyclic redundancy check and the three-byte header and not use inter byte separation or checksums";

(c) ISO 14229-3:2012: "Road vehicles — Unified Diagnostic Services (UDS) — Part 3: Unified diagnostic services on CAN implementation";

(d) ISO 14229-4:2012: "Road vehicles — Unified diagnostic services (UDS) — Part 4: Unified diagnostic services on FlexRay implementation";

(e) ISO 14230-4:2000: "Road Vehicles — Keyword protocol 2000 for diagnostic systems — Part 4: Requirements for emission-related systems";

(f) ISO 15765-4:2011: "Road vehicles — Diagnostics on Controller Area Network (CAN) — Part 4: Requirements for emissions-related systems", dated 1 November 2001;

(g) ISO 22901-2:2011: "Road vehicles — Open diagnostic data exchange (ODX) — Part 2: Emissions-related diagnostic data".

3.9. Test equipment and generic scan tool needed to communicate with OBD systems shall meet or exceed the functional specification in ISO 15031-4:2005:

"Road vehicles — Communication between vehicle and external test equipment for emissions-related diagnostics — Part 4: External test equipment".

3.10. Basic diagnostic data (as specified in paragraph 3) and bi-directional control information shall be provided using the format and units described in ISO 15031-5:2011; "Road vehicles - communication between vehicles and external test equipment for emissions-related diagnostics – Part 5: Emissions-related diagnostic services", dated 1 April 2011 or SAE J1979 dated 23 February 2012, and shall be available using a generic scan tool meeting the requirements of ISO 15031-4:2005.

3.10.1. The vehicle manufacturer shall provide the approval authority with details of any diagnostic data, e.g. PIDs, OBD monitor IDs, Test IDs not specified in ISO 15031-5:2011 but relating to this Regulation.

3.11. When a fault is registered, the manufacturer shall identify the fault using an appropriate diagnostic trouble code consistent with those in ISO 15031-6:2010 'Road vehicles — Communication between vehicle and external test equipment for emissions-related diagnostics — Part 6: Diagnostic trouble code definitions' dated 13 August 2010 or SAE J2012 dated 07 March 2013; relating to 'emission-related system diagnostic trouble codes'. If this is not possible, the manufacturer may use the diagnostic trouble codes of ISO DIS 15031-6:2010. Alternatively, fault codes may be compiled and reported in accordance with ISO14229:2006. The fault codes shall be fully accessible by standardised diagnostic equipment complying with paragraph 3.9.

3.11.1. The vehicle manufacturer shall provide to a national standardisation body the details of any emission-related diagnostic data, e.g. PIDs, OBD monitor IDs, Test IDs not specified in ISO 15031-5:2011 or ISO14229:2006, but relating to this UN GTR.

3.12. The connection interface between the vehicle and the diagnostic tester shall be standardised and meet all the requirements of ISO 19689:2016'Motorcycles and mopeds — Communication between vehicle and external equipment for diagnostics — Diagnostic connector and related electrical circuits, specification and use' or ISO 15031-3:2004 'Road vehicles — Communication between vehicle and external test equipment for emissions-related diagnostics — Part 3: Diagnostic connector and related electric circuits: specification and use'. The preferred installation position is under the seating position. Any other position of the diagnostic connector shall be subject to the approval authority's agreement and be readily accessible by service personnel but protected from tampering by non-qualified personnel. The position of the connection interface shall be clearly indicated in the user manual.

3.13. The vehicle manufacturer may use an alternative connection interface upon request. Where an alternative connection interface is used, the vehicle manufacturer shall provide an adapter enabling connection to a generic scan tool. Such an adapter shall be provided in a non-discriminating manner to all independent operators.

4. Each monitor of the OBD system shall be executed

4.1. General requirements

4.1.1. Each monitor of the OBD system shall be executed at least once per driving cycle, in which the monitoring conditions in paragraph 5.3.11. of this regulation are met. Manufacturers shall not use the calculated ratio (or any element thereof) or any other indication of monitor frequency as a monitoring condition for any monitor.

4.1.2. The in-use performance ratio ('IUPR') of a specific monitor M of the OBD systems and in-use performance of pollution control devices shall be:

Equation 1-1:

$IUPR_M$ = NumeratorM/DenominatorM

4.1.3. Comparison of Numerator and Denominator gives an indication of how often a specific monitor is operating relative to vehicle operation. To ensure all manufacturers are tracking $IUPR_M$ in the same manner, detailed requirements are given for defining and incrementing these counters.

4.1.4. -The manufacturer shall demonstrate to the approval authority the functionality of IUPR determination.

If, in accordance with the requirements of this Annex, the vehicle is equipped with a specific monitor M, $IUPR_M$ shall be greater than or equal to 0.1 for all monitors M.

4.1.5. The requirements of this point are deemed to be met for a particular monitor M, if for all vehicles of a particular vehicle and propulsion family manufactured in a particular calendar year the following statistical conditions hold:

(a) The average $IUPR_M$ is equal or above the minimum value applicable to the monitor;

(b) More than 50 % of all vehicles have an $IUPR_M$ equal or above the minimum value applicable to the monitor.

4.1.6. The manufacturer shall demonstrate to the approval authority that these statistical conditions are satisfied for vehicles manufactured in a given calendar year for all monitors required to be reported by the OBD system according to paragraph 4.6 of this Annex not later than 18 months after the end of a calendar year. For this purpose, statistical tests shall be used which implement recognised statistical principles and confidence levels.

4.1.7. For demonstration purposes of this point, the manufacturer may group vehicles within a vehicle and propulsion family by any successive non-overlapping 12-month manufacturing periods instead of calendar years. For establishing the test sample of vehicles, at least the selection criteria of Annex 3, paragraph 3 shall be applied. For the entire test sample of vehicles, the manufacturer shall report to the approval authority all of the in-use performance data to be reported by the OBD system in accordance with paragraph 4.6 of this Annex. Upon request, the approval authority which grants the approval shall make these data and the results of the statistical evaluation available to other approval authorities.

4.1.8. The approval authority and the technical service may pursue further tests on vehicles or collect appropriate data recorded by vehicles to verify compliance with the requirements of this Annex.

4.1.9. In-use performance-related data to be stored and reported by a vehicle's OBD system shall be made readily available by the manufacturer to national authorities and independent operators without any encryption.

4.2. NumeratorM

4.2.1. The numerator of a specific monitor is a counter measuring the number of times a vehicle has been operated in such a way that all monitoring conditions necessary for the specific monitor to detect a malfunction in order to warn the driver, as they have been implemented by the manufacturer, have been encountered. The numerator shall not be incremented more than once per driving cycle, unless there is reasoned technical justification.

4.3. DenominatorM

4.3.1. The purpose of the denominator is to provide a counter indicating the number of vehicle driving events, taking into account special conditions for a specific monitor. The denominator shall be incremented at least once per driving cycle, if during this driving cycle such conditions are met and the general denominator is incremented as specified in paragraph 4.5, unless the denominator is disabled according to paragraph 4.7.

4.3.2. In addition to the requirements of paragraph 4.3.1:

Secondary air system monitor denominator(s) shall be incremented if the commanded 'on' operation of the secondary air system occurs for a time greater than or equal to 10 seconds. For purposes of determining this commanded 'on' time, the OBD system shall not include time during intrusive operation of the secondary air system solely for the purposes of monitoring.

Denominators of monitors of systems only active during cold start shall be incremented if the component or strategy is commanded 'on' for a time greater than or equal to 10 seconds.

The denominator(s) for monitors of Variable Valve Timing (VVT) and/or control systems shall be incremented if the component is commanded to function (e.g. commanded 'on', 'open', 'closed', 'locked', etc.) on two or more occasions during the driving cycle or for a time greater than or equal to 10 seconds, whichever occurs first.

For the following monitors, the denominator(s) shall be incremented by one if, in addition to meeting the requirements of this point on at least one driving cycle, at least 800 cumulative kilometres of vehicle operation have been experienced since the last time the denominator was incremented:

(i) Diesel oxidation catalyst;

(ii) Diesel particulate filter.

4.4. Ignition Cycle Counter

4.4.1. The ignition cycle counter indicates the number of ignition cycles a vehicle has experienced. The ignition cycle counter may not be incremented more than once per driving cycle.

4.5. General Denominator

[4.5.1. The general denominator is a counter measuring the number of times a vehicle has been operated. It shall be incremented within 10 seconds, if the following criteria are satisfied on a single driving cycle:

(a) Cumulative time since engine start is greater than or equal to 600 seconds at an elevation of less than 2 440 m above sea level or an ambient pressure of more than 75.7 kPa and an ambient temperature of 266.2 K (– 7 °C) or more;

(b) Cumulative vehicle operation at or above 25 km/h occurs for 300 seconds or more at an elevation of less than 2 440 m above sea level or an ambient pressure of more than 75.7 kPa and an ambient temperature of 266.2 K (– 7 °C) or more;

(c) Continuous vehicle operation at idle (i.e. accelerator pedal released by driver and vehicle speed of 1.6 km/h or less) for 30 seconds or more at an elevation of less than 2 440 m above sea level or an ambient pressure of more than 75.7 kPa and an ambient temperature of 266.2 K (– 7 °C) or more.

The general denominator may also be incremented outside the boundary conditions for altitude or ambient pressure and ambient temperature.]

4.6. Reporting and increasing counters

4.6.1. The OBD system shall report in accordance with the ISO 15031-5:2011 specifications the ignition cycle counter and general denominator as well as separate numerators and denominators for the following monitors, if their presence on the vehicle is required by this Annex:

(a) Catalysts (each bank to be reported separately);

(b) Oxygen/exhaust gas sensors, including secondary oxygen sensors (each sensor to be reported separately);

(c) Evaporative system;

(d) Exhaust Gas Recirculation (EGR) system;

(e) Variable Valve Train (VVT) system;

(f) Secondary air system;

(g) Particulate filter;

(h) NOx after-treatment system (e.g. NOx adsorber, NOx reagent/catalyst system);

(i) Boost pressure control system.

4.6.2. For specific components or systems that have multiple monitors which have to be reported under this point (e.g. oxygen sensor bank 1 may have multiple monitors for sensor response or other sensor characteristics), the OBD system shall separately track numerators and denominators for each of the specific monitors and report only the corresponding numerator and denominator for the specific monitor that has the lowest numerical ratio. If two or more specific monitors have identical ratios, the corresponding numerator and denominator for the specific monitor that has the highest denominator shall be reported for the specific component.

4.6.2.1. Numerators and denominators for specific monitors of components or systems that are monitoring continuously for short circuit or open circuit failures are exempted from reporting.

Commented [DL15]: [4.5.1] accepted at EPPR-35, at IMMA´s request.
IMMA urged to prepare a counterproposal
for the June session

Commented [DL16R15]: Sq. brackets removed at EPPR-36.
A clarification will be added in the Tech Report,
not in the GTR text

Commented [DL17]: confirmed at June EPPR-36

For the purposes of this point, "continuously" means monitoring is always enabled and sampling of the signal used for monitoring occurs at a rate no less than two samples per second and the presence or the absence of the failure relevant to that monitor has to be concluded within 15 seconds. If for control purposes, a computer input component is sampled less frequently, the signal of the component may instead be evaluated each time sampling occurs.It is not required to activate an output component/system for the sole purpose of monitoring that output component/system.

4.6.3. All counters, when incremented, shall be incremented by an integer of one.

4.6.4. The minimum value of each counter is 0; the maximum value shall not be less than 65535, notwithstanding any other requirements regarding standardised storage and reporting of the OBD system.

4.6.5. If either the numerator or denominator for a specific monitor reaches its maximum value, both counters for that specific monitor shall be divided by two before being incremented again in accordance with paragraphs 4.2 and 4.3. If the ignition cycle counter or the general denominator reaches its maximum value, the respective counter shall change to zero at its next increment in accordance with paragraphs 4.4 and 4.5 respectively.

4.6.6. Each counter shall be reset to zero only when a non-volatile memory reset occurs (e.g. reprogramming event, etc.) or, if the numbers are stored in keep-alive memory (KAM), when KAM is lost due to an interruption in electrical power to the control module (e.g. battery disconnect, etc.).

4.6.7. The manufacturer shall take measures to ensure that the values of numerator and denominator cannot be reset or modified, except in cases provided for explicitly in this point.

4.7. Disablement of Numerators and Denominators and of the General Denominator

4.7.1. Within 10 seconds of detection of a malfunction which disables a monitor required to meet the monitoring conditions of this Annex (i.e. a pending or confirmed code is stored), the OBD system shall disable further incrementing of the corresponding numerator and denominator for each monitor that is disabled. When the malfunction is no longer detected (i.e. the pending code is erased through self-clearing or a scan tool command), incrementing of all corresponding numerators and denominators shall resume within 10 seconds.

4.7.2. Within 10 seconds of the start of a power take-off unit (PTO) that disables a monitor required to meet the monitoring conditions of this Annex, the OBD system shall disable further incrementing of the corresponding numerator and denominator for each monitor that is disabled. When the PTO operation ends, incrementing of all corresponding numerators and denominators shall resume within 10 seconds.

4.7.3. The OBD system shall disable further incrementing of the numerator and denominator of a specific monitor within 10 seconds, if a malfunction of any component used to determine the criteria within the definition of the specific monitor's denominator (i.e. vehicle speed, ambient temperature, elevation, idle operation, engine cold start or time of operation) has been detected and the corresponding pending fault code has been stored. Incrementing of the numerator and denominator shall resume within 10 seconds when the malfunction is no longer present (e.g. pending code erased through self-clearing or by a scan tool command).

4.7.4. The OBD system shall disable further incrementing of the general denominator within 10 seconds if a malfunction has been detected of any component used to determine whether the criteria in paragraph 4.5 are satisfied (i.e. vehicle speed, ambient temperature, elevation, idle operation or time of operation) and the corresponding pending fault code has been stored. The general denominator may not be disabled from incrementing for any other condition. Incrementing of the general denominator shall resume within 10 seconds when the malfunction is no longer present (e.g. pending code erased through self-clearing or by a scan tool command).

5. Access to OBD information

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

5.2. Upon request, the approval authority shall make the repair information on the OBD system available to any interested components, diagnostic tools or test equipment manufacturer on a non-discriminatory basis:

5.2.1. A description of the type and number of preconditioning cycles used for the original approval of the vehicle;

5.2.2. A description of the type of the OBD demonstration cycle used for the original approval of the vehicle for the component monitored by the OBD system;

5.2.3. A comprehensive document describing all sensed components with the strategy for fault detection and MI activation (fixed number of driving cycles or statistical method), including a list of relevant secondary sensed parameters for each component monitored by the OBD system and a list of all OBD output codes and format used (with an explanation of each) associated with individual emission related powertrain components and individual non-emission related components, where monitoring of the component is used to determine MI activation.

5.2.4. This information may be provided in the form of a table, as follows:

Table A1/1 Template OBD information list

Commented [DL18]: sq. brackets deleted, in order to align with Euro 5 EU 44/2014

As agreed at EPPR-35 OBD2CG-18-02 (IMMA)

Component	*Diagnostic trouble code*	*Monitoring strategy*	*Fault detection criteria*	*MI activation criteria*	*Secondary parameters*	*Preconditioning*	*Demonstration test*	*Default mode*
Catalyst	P0420	Oxygen sensor 1 and 2 signals	Difference between sensor 1 and sensor 2 signals	3rd cycle	Engine speed, engine load, A/F mode, catalyst temperature	Two type I cycles	Type I	None

5.2.5. If an approval authority receives a request from any interested components, diagnostic tools or test equipment manufacturer for information on the OBD system of a vehicle that has been approved by that approval authority to a previous version of this Regulation (if any),

(a) That approval authority shall, within 30 days, ask the manufacturer of the vehicle in question to make available the information required in paragraphs 5.1 and 5.2.~~.~~;

(b) The vehicle manufacturer shall submit this information to that approval authority within two months of the request;

(c) That approval authority shall transmit this information to the other Contracting Parties' approval authorities and shall attach this information to the vehicle approval information.

5.2.6. Information can be requested only for replacement or service components that are subject to approval or for components that form part of a system subject to approval.

5.2.7. The request for repair information shall identify the exact specification of the vehicle model for which the information is required. It shall confirm that the information is required for the development of replacement or retrofit parts or components or diagnostic tools or test equipment.

5.2.8. Access to vehicle security features used by authorised dealers and repair shops shall be made available to independent operators under protection of security technology according to the following requirements:

(a) Data shall be exchanged ensuring confidentiality, integrity and protection against replay;

(b) The standard https//ssl-tls (RFC4346) shall be used;

(c) Security certificates in accordance with ISO 20828 shall be used for mutual authentication of independent operators and manufacturers;

(d) The independent operator's private key shall be protected by secure hardware.

5.2.8.1. The Contracting Parties will specify the parameters for fulfilling these requirements according to the state of the art.

5.2.8.2. The independent operator shall be approved and authorized for this purpose on the basis of documents demonstrating that they pursue a legitimate business activity and have not been convicted of relevant criminal activity.]

Annex 2

Minimum monitoring requirements for electric circuit diagnostics of an On-Board Diagnostic (OBD) system

1. Subject Matter

The following minimum monitoring requirements shall apply for OBD systems regarding electric circuit diagnostics.

2. Scope and monitoring requirements

a) If fitted, the following listed sensors and actuators shall be monitored for electric circuit malfunctions which may cause emissions to exceed the designated OBD threshold limits laid down to in paragraph 5.5.1. of general requirements.

b) If fitted, a Contracting Party may require in addition that the following listed sensors and actuators shall be monitored for electric circuit malfunctions which may lead to activation of a default mode that results in a significant reduction of propulsion torque.

2.1 At a minimum the monitored devices with mandatory circuit diagnostics shall be the following:

Table A2/1: Overview of devices (if fitted) to be monitored in OBD

No.	*Device circuits*		*Circuit continuity*			*Circuit rationality*			*Basic monitoring requirement*	*Comment No.*
		Level, refer to 2.3.	**Circuit High**	**Circuit Low**	**Open Circuit**	**Out of Range**	**Performance / Plausibility**	**Signal stuck**	**Device not operational / Device not present**	
1	Control module (ECU / PCU) internal error	3							Yes	(1)
	Sensor (input to control units)									
1	Accelerator (pedal / handle) position sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(2)
2	Barometric pressure sensor	1	Yes	Yes	Yes		Yes			
3	Camshaft position sensor	3							Yes	
4	Crankshaft position sensor	3							Yes	
5	Engine coolant temperature sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(3)
6	Exhaust control valve angle sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(3)
7	Exhaust gas recirculation sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(3)
8	Fuel rail pressure sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(3)
9	Fuel rail temperature sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(3)
10	Gear shift position sensor (potentiometer type)	1	Yes	Yes	Yes	Yes	Yes	Yes		(3) (4)
11	Gear shift position sensor (switch type)	3					Yes		Yes	(4)
12	Intake air temperature sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(3)
13	Knock sensor (Non-resonance type)	3							Yes	
14	Knock sensor (Resonance type)	3					Yes			
15	Manifold absolute pressure sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(3)

No.	*Device circuits*		*Circuit continuity*			*Circuit rationality*			*Basic monitoring requirement*	*Comment No.*
		Level, refer to 2.3.	**Circuit High**	**Circuit Low**	**Open Circuit**	**Out of Range**	**Performance / Plausibility**	**Signal stuck**	**Device not operational / Device not present**	
16	Mass air flow sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(3)
17	Engine oil temperature sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(3)
18	O_2 exhaust sensor (binary / linear) signals	1	Yes	Yes	Yes	Yes	Yes	Yes		(3)
19	Fuel (high) pressure sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(3)
20	Fuel storage temperature sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(3)
21	Throttle position sensor	1	Yes	Yes	Yes	Yes	Yes	Yes		(2)
22	Vehicle speed sensor	3					Yes		Yes	(4)
23	Wheel speed sensor	3					Yes		Yes	(4)
	Actuators (output control units)									
1	Evaporative emission system purge control valve	2	Yes	Yes	Yes				Yes	(5)
2	Exhaust control valve actuator (motor driven)	3					Yes		Yes	
3	Exhaust gas recirculation control	3					Yes			
4	Fuel injector	2		Yes					Yes	(5)
5	Idle air control system	1	Yes	Yes	Yes		Yes		Yes	(5)
6	Ignition coil primary control circuits	2		Yes					Yes	(5)
7	O_2 exhaust sensor heater	1	Yes	Yes	Yes		Yes		Yes	(5)
8	Secondary air injection system	2	Yes	Yes	Yes				Yes	(5)
9	Throttle by wire actuator	3		Yes					Yes	(5)

Comments:

(1) In case ECU/PCU is operating at reduced functionality and when it generates internal fault/error due to malfunction of hardware or software, then:

(a) Monitoring applicable in case of a throttle by wire system being fitted.

(b) In addition, a Contracting Party may require monitoring in case of an activated default mode leading to a significantly reduced propulsion torque.

(2) If redundant APS or redundant TPS are fitted, signal cross check(s) shall meet all circuit rationality requirements. If there is only one APS or TPS fitted, APS or TPS circuit rationality monitoring is not mandatory.

(3) Two out of three of the circuit rationality malfunctions shall be monitored in addition to circuit continuity monitoring.

(4) Only if used as input to ECU/PCU with relevance to environmental or functional safety performance.

(5) Derogation allowed if manufacturer requests, level 3 instead, actuator signal present only without indication of symptom.

2.2. If there are more of the same device types fitted on the vehicle listed in Table A2/1 of Annex 2, those devices shall be separately monitored and reported in case of malfunctions.

2.3. Sensors and actuators shall be associated with a specific diagnostic level that defines which type of diagnostic monitoring shall be performed as follows:

2.3.1. Level 1: sensor/actuator of which at least two circuit continuity symptoms can be detected and reported (i.e. short circuit to ground, short circuit to power and open circuit).

2.3.2. Level 2: sensor/actuator of which at least one circuit continuity symptom can be detected and reported (i.e. short circuit to ground, short circuit to power and open circuit).

2.3.3. Level 3: sensor/actuator of which at least one symptom can be detected, but not reported separately.

2.4. Two out of three symptoms in circuit continuity as well as in circuit rationality monitoring diagnostic may be combined, e.g.

– circuit high or open and low circuit;

– high and low or open circuit;

– signal out of range or circuit performance and signal stuck;

– circuit high and out of range high or circuit low and out of range low.

2.5. Exemptions regarding detection

Exemption from detecting certain electric circuit monitoring symptoms may be granted in the following cases if the manufacturer can demonstrate to the satisfaction of the approval authority that:

2.5.1. a listed malfunction will not cause emissions to exceed the designated OBD threshold limits set out in paragraph 5.5.1. of general requirements; or

2.5.2. a listed malfunction will not cause a significant torque loss; or

2.5.3. the only feasible monitoring strategy would negatively affect vehicle functional safety or driveability in a significant way.

2.6. Exemption regarding OBD emission verification tests (test type VIII)

At the request of the manufacturer and based on a technical justification to the satisfaction of the approval authority, certain OBD monitors listed in Table A2/1- of Annex 2 may be exempted from test type VIII emission verification tests referred to in Annex 6 under the condition that the manufacturer can demonstrate to the approval authority that:

2.6.1. The malfunction indicator fitted to the vehicle is activated when the malfunction listed in Table A2/1 of Annex 2 occurs:

2.6.1.1. During the same key cycle and;

2.6.1.2. Immediately after expiration of a limited time delay (300 s or less) in that same key cycle; or

2.6.2. Monitoring of some of the items listed in Table A2/1 of Annex 2 is physically not possible and a deficiency has been granted for this incomplete monitor. The comprehensive, technical justification why such an OBD monitor cannot run shall be added to the information folder.

Annex 3 In-use performance ratio

1. Introduction

1.1. This Annex sets out the in-use performance ratio of a specific monitor M of the OBD systems (IUPR M) requirements for vehicles in the scope of this regulation, approved in accordance with this Regulation.

2. Audit of IUPR M

2.1. At the request of the approval authority, the manufacturer shall report to the type-approval authority on warranty claims, warranty repair works and OBD faults recorded at servicing, according to a format agreed at type-approval. The information shall detail the frequency and substance of faults for emissions-related components and systems. The reports shall be filed at least once in the vehicle's production cycle, for each vehicle model for the duration of 5 years of age or the distance as specified in the durability test by the contracting party, whichever is sooner.

2.2. Parameters defining IUPR family

For defining the IUPR family the OBD family parameters listed in Annex 5 shall be used.

2.3. Information requirements

An audit of IUPR M will be conducted by the approval authority on the basis of information supplied by the manufacturer. Such information shall include in particular, the following:

2.3.1. The name and address of the manufacturer;

2.3.2. The name, address, telephone and fax numbers and e-mail address of his authorised representative within the areas covered by the manufacturer's information;

2.3.3. The model name(s) of the vehicles included in the manufacturer's information;

2.3.4. Where appropriate, the list of vehicle types covered within the manufacturer's information, i.e. for OBD and IUPR M, the OBD family in accordance with Annex 5;

2.3.5. The vehicle identification number (VIN) codes applicable to these vehicle types within the family (VIN prefix);

2.3.6. The numbers of the approvals applicable to these vehicle types within the IUPR family, including, where applicable, the numbers of all extensions and field fixes/recalls (re-works);

2.3.7. Details of extensions, field fixes/recalls to those type-approvals for the vehicles covered within the manufacturer's information (if requested by the approval authority);

2.3.8. The period of time over which the manufacturer's information was collected;

2.3.9. The vehicle build period covered within the manufacturer's information (e.g. vehicles manufactured during the 2017 calendar year);

2.3.10 The manufacturer's IUPR M checking procedure, including:

(a) vehicle location method;

(b) vehicle selection and rejection criteria;

(c) test types and procedures used for the programme;

(d) the manufacturer's acceptance/rejection criteria for the family group;

(e) geographical area(s) within which the manufacturer has collected information;

(f) sample size and sampling plan used.

2.3.11. The results from the manufacturer's IUPR M procedure, including:

(a) identification of the vehicles included in the programme (whether tested or not). The identification shall include the following:

• model name;

• vehicle identification number (VIN);

• region of use (where known)

• date of manufacture.

(b) the reason(s) for rejecting a vehicle from the sample:

(c) test data, including the following:

• date of test/download;

• location of test/download;

• all data, as required in accordance with paragraph ~~4.1.6~~4.6.1. of Annex 1, downloaded from the vehicle;

• for each monitor to be reported the in-use-performance ratio.

2.3.12. For IUPR M sampling, the following:

(a) the average of in-use-performance ratios IUPR M of all selected vehicles for each monitor in accordance with paragraph 4.1.4. of Annex 1.

Commented [DL19]: Text was in line with EU 44/2016, But it should be 4.6.1. of Annex 1

As agreed at EPPR-35
OBD2CG-18-02 (IMMA)

(b) The percentage of selected vehicles, which have an IUPR M greater or equal to the minimum value applicable to the monitor in accordance with paragraph 4.1.4. of Annex 1.

3. Selection of vehicles for IUPR M

3.1. The manufacturer's sampling shall be drawn from at least two different geographical regions with substantially different vehicle operating conditions. Factors such as differences in fuels, ambient conditions, average road speeds, and urban/highway driving split shall be taken into consideration in the selection.

3.2. In selecting the geographical regions for sampling vehicles, the manufacturer may select vehicles from a geographical region that is considered to be particularly representative. In this case, the manufacturer shall demonstrate to the approval authority which granted the approval that the selection is representative (e.g. by the market having the largest annual sales of a vehicle family within the Contracting Party). When a family requires more than one sample lot to be tested as defined in paragraph 3.3, the vehicles in the second and third sample lots shall reflect different vehicle operating conditions from those selected for the first sample.

3.3. Sample size

3.3.1. The number of sample lots shall depend on the annual sales volume of an OBD family in the Contracting Party, as defined in the following table:

Table A3/1: Number of sample lots

Contracting Party registrations - per calendar year (for tailpipe emissions tests) - of vehicles of an OBD family with IUPR in the sampling period	Number of sample lots
up to 100 000	1
100 001 to 200 000	2
above 200 000	3

3.3.2 For IUPR, the number of sample lots to be taken is described in the table in paragraph 3.3.1. (Table A3/1 of Annex 3) and is based on the number of vehicles of an IUPR family that are approved with IUPR

For the first sampling period of an IUPR family, all of the vehicle types in the family that are approved with IUPR shall be considered to be subject to sampling. For subsequent sampling periods, only vehicle types which have not been previously tested or are covered by emissions approvals that have been extended since the previous sampling period shall be considered to be subject to sampling.

For families consisting of fewer than 5 000 Contracting Party registrations that are subject to sampling within the sampling period, the minimum number of vehicles in a sample lot is six. For all other families, the minimum number of vehicles in a sample lot to be sampled is fifteen.

Each sample lot shall adequately represent the sales pattern, i.e. at least high volume vehicle types (≥ 20 % of the family total) shall be represented.

Commented [DL20]: Comma added, for sake of clarity

Vehicles of small series productions with less than 1000 vehicles per OBD family are exempted from minimum IUPR requirements as well as the requirement to demonstrate these to the B56approval authority.

4. On the basis of the audit referred to in Section 2 the approval authority shall adopt one of the following decisions and actions:

(a) decide that the IUPR family is satisfactory and not take any further action;

(b) decide that the data provided by the manufacturer is insufficient to reach a decision and request additional information or test data from the manufacturer;

(c) decide that based on data from the approval authority or Contracting Party surveillance testing programmes, that information provided by the manufacturer is insufficient to reach a decision and request additional information or test data from the manufacturer;

(d) decide that the outcome of the audit for the IUPR family is unsatisfactory and proceed to have such vehicle type or IUPR family tested in accordance with paragraph 4 in Annex 1.

If according to the IUPR M audit the test criteria of paragraph 3.2. of Annex 4 are met for the vehicles in a sample lot, the approval authority must take the further action described in point (d) of this point.

4.1. The approval authority, in cooperation with the manufacturer, shall select a sample of vehicles with sufficient mileage whose use under normal conditions can be reasonably assured. The manufacturer shall be consulted on the choice of the vehicles in the sample and allowed to attend the confirmatory checks of the vehicles.

Annex 4 Selecting criteria for vehicles with respect to in use performance ratios

1. Introduction

1.1. This Annex sets out the criteria referred to in Section 4 of Annex 1 regarding the selection of vehicles for testing and the procedures for IUPR M.

2. Selection criteria
The criteria for acceptance of a selected vehicle are defined for IUPR M in Sections 2.1. to 2.5.

2.1. The vehicle shall belong to a vehicle type that is approved under this Regulation. It shall be registered and have been used in the territory of the Contracting Party.

2.2. The vehicle shall have been in service for at least 3 000 km or 6 months, whichever the later, and for no more than the durability mileages given for the relevant vehicles category mentioned in the durability provisions specified by the contracting party or 5 years, whichever the sooner.

2.3. For checking IUPR M, the test sample shall include only vehicles that:

(a) have collected sufficient vehicle operation data for the monitor to be tested. For monitors required to meet the in-use monitor performance ratio and to track and report ratio data pursuant to paragraph 4.6.1. of Annex 1, sufficient vehicle operation data shall mean the denominator meets the criteria set forth below.

The denominator, as defined in paragraphs 4.3 and 4.5 of Annex 1, for the monitor to be tested must have a value equal to or greater than one of the following values:

(i) 15 for evaporative system monitors, secondary air system monitors, and monitors utilising a denominator incremented in accordance with paragraph 4.3.2. of Annex 1 (e.g. cold start monitors, air conditioning system monitors, etc.); or

(ii) 5 for particulate filter monitors and oxidation catalyst monitors utilising a denominator incremented in accordance with paragraph 4.3.2. of Annex 1; or

(iii) 30 for catalyst, oxygen sensor, EGR, VVT, and all other component monitors.

(b) have not been tampered with or equipped with add-on or modified parts that would cause the OBD system not to comply with the requirements of this regulation.

2.4. If any service has taken place, it shall be to the manufacturer's recommended service intervals.

2.5. The vehicle shall exhibit no indications of abuse (e.g. racing, overloading, mis-fuelling, or other misuse), or other factors (e. g. tampering) that could affect emission performance. The fault code and mileage information stored in the computer shall be taken into account. A vehicle shall not be selected for testing if the information stored in the computer shows that the vehicle has operated after a fault code was stored and a relatively prompt repair was not carried out.

2.6. There shall have been no unauthorised major repair to the engine or major repair of the vehicle.

3. Plan of remedial measures

3.1. The approval authority shall request the manufacturer to submit a plan of remedial measures to remedy the non-compliance when:

3.2 For $IUPR_M$ of a particular monitor M the following statistical conditions are met in a test sample, the size of which is determined in accordance with paragraph 3.3.1. of Annex 3.

For vehicles certified to a ratio of 0.1 in accordance with paragraph 4.1.4. of Annex 1, the data collected from the vehicles indicate for at least one monitor M in the test sample either that the test sample average in-use-performance ratio is less than 0.1 or that 66 per cent or more of the vehicles in the test sample have an in-use monitor performance ratio of less than 0.1.

3.3. The plan of remedial measures shall be filed with the approval authority not later than 60 working days from the date of the notification referred to in paragraph 3.1. The approval authority shall within 30 working days declare its approval or disapproval of the plan of remedial measures. However, where the manufacturer can demonstrate, to the satisfaction of the competent approval authority, that further time is required to investigate the non-compliance in order to submit a plan of remedial measures, an extension is granted.

3.4. The remedial measures shall apply to all vehicles likely to be affected by the same defect. The need to amend the approval documents shall be assessed.

3.5. The manufacturer shall provide a copy of all communications related to the plan of remedial measures, and shall also maintain a record of the recall campaign, and supply regular status reports to the approval authority.

3.6 The plan of remedial measures shall include the requirements specified in paragraphs 3.6.1. to 3.6.11. The manufacturer shall assign a unique identifying name or number to the plan of remedial measures.

3.6.1. A description of each vehicle type included in the plan of remedial measures.

3.6.2. A description of the specific modifications, alterations, repairs, corrections, adjustments, or other changes to be made to bring the vehicles into conformity including a brief summary of the data and technical studies which support the manufacturer's decision as to the particular measures to be taken to correct the non-conformity.

3.6.3. A description of the method by which the manufacturer informs the vehicle owners.

3.6.4. A description of the proper maintenance or use, if any, which the manufacturer stipulates as a condition of eligibility for repair under the plan of remedial measures, and an explanation of the manufacturer's reasons for imposing any such condition. No maintenance or use conditions may be imposed unless it is demonstrably related to the non-conformity and the remedial measures.

3.6.5. A description of the procedure to be followed by vehicle owners to obtain correction of the non-conformity. This shall include a date after which the remedial measures may be taken, the estimated time for the workshop to perform the repairs and where they can be done. The repair shall be done expediently, within a reasonable time after delivery of the vehicle.

3.6.6. A copy of the information transmitted to the vehicle owner.

3.6.7. A brief description of the system which the manufacturer uses to assure an adequate supply of component or systems for fulfilling the remedial action. It shall be indicated when there will be an adequate supply of components or systems to initiate the campaign.

3.6.8. A copy of all instructions to be sent to those persons who are to perform the repair.

3.6.9. A description of the impact of the proposed remedial measures on the emissions, fuel consumption, driveability, and safety of each vehicle type, covered by the plan of remedial measures with data, technical studies, etc. which support these conclusions.

3.6.10. Any other information, reports or data the approval authority may reasonably determine is necessary to evaluate the plan of remedial measures.

3.6.11. Where the plan of remedial measures includes a recall, a description of the method for recording the repair shall be submitted to the approval authority. If a label is used, an example of it shall be submitted.

3.7. The manufacturer may be required to conduct reasonably designed and necessary tests on components and vehicles incorporating a proposed change, repair, or modification to demonstrate the effectiveness of the change, repair, or modification.

3.8. The manufacturer is responsible for keeping a record of every vehicle recalled and repaired and the workshop which performed the repair. The approval

authority shall have access to the record on request for a period of 5 years from the implementation of the plan of remedial measures.

3.9. The repair and/or modification or addition of new equipment shall be recorded in a certificate supplied by the manufacturer to the vehicle owner.

Annex 5 On-board diagnostics family for IUPR

1. Introduction

1.1. This Annex sets out the criteria to define a OBD family as referred to in Annexes 3 and 4

2. Selection criteria

2.1. Vehicle types for which at least the parameters described below are identical are considered to belong to the same engine/emission control/OBD system combination.

2.2 Engine:

– combustion process (i.e. positive-ignition/compression-ignition, two stroke/four stroke/rotary),

– method of engine fuelling (i.e. single or multi-point fuel injection),

– fuel type (i.e. petrol, diesel),

2.3 Emission control system:

– type of catalytic converter (i. e. oxidation, three-way, heated catalyst, SCR, other),

– type of particulate trap,

– secondary air injection (i.e. with or without),

– exhaust gas recirculation (i.e. with or without),

2.4 OBD parts and functioning:

– the methods of OBD functional monitoring, malfunction detection and malfunction indication to the vehicle driver.

Annex 6 Test type VIII requirements: OBD environmental tests

1. Introduction

1.1. This Annex describes the procedure for type VIII testing on environmental on-board diagnostics (OBD). The procedure describes methods for checking the function of the OBD system on the vehicle by simulating failure of emission-relevant components in the powertrain management system and emission-control system.

1.2. The manufacturer shall make available the defective components or electrical devices to be used to simulate failures. When measured over the appropriate test type I cycle, such defective components or devices shall not cause the

vehicle emissions to exceed by more than 20 percent the OBD threshold limits set out in paragraph 5.5.1. of general requirements. For failures (circuit continuity/circuit rationality/basic monitoring requirement), the emissions may exceed the OBD threshold limits set out in paragraph 5.5.1. of general requirements by more than twenty per cent.

1.3. When the vehicle is tested with the defective component or device fitted, the OBD system shall be approved if the malfunction indicator is activated. The system shall also be approved if the malfunction indicator is activated below the OBD threshold limits.

2. The test procedures in this Annex shall be mandatory for vehicles equipped with an OBD system. This obligation concerns compliance with all provisions of this Annex.

3. Description of tests

3.1. Test vehicle

3.1.1. The environmental OBD verification and demonstration tests shall be carried out on a test vehicle, that shall be properly maintained and used, dependent on the chosen durability test method using the test procedures set-out in this Annex and in the applicable World-harmonised Motorcycle Test Cycle (WMTC) set out in UN GTR No 2.

3.1.2. In case of applying the durability test procedure, the test vehicles shall be equipped with the aged emission components used for durability tests as well as for the purposes of this Annex and the OBD environmental tests shall be finally verified and reported at the conclusion of the durability testing. At the request of the manufacturer, a suitable aged and representative vehicle may be used for these OBD demonstration tests.

3.1.3. In case the OBD demonstration test requires emission measurements, the type VIII test shall be carried out on the test vehicles used for the durability test. Type VIII tests shall be finally verified and reported at the conclusion of the durability testing.

3.1.4. In case of applying the fixed deterioration factors (DF) set out in GTR No.2, the applicable deterioration factors shall be multiplied with the emission test results. If the approval authority allows, in case of misfire demonstration, alternatively experimentally determined deterioration factors from the durability test may be used. This demo method may be used to avoid damage during misfire testing to the deteriorated catalyst created by durability testing and may be used on request of the manufacturer if it submits data and/or an engineering evaluation which adequately demonstrates to the approval authority the risk of damage to the deteriorated catalyst.

3.1.5. Until the UN GTR on Durability gets finalized, the Contracting Parties can follow their regional durability procedure.

3.2. a) The OBD system shall indicate the failure of an emission-related component or system when that failure results in emissions exceeding the OBD threshold limits in paragraph 5.5.1. of general requirements.

b) A Contracting Party may require in addition that the OBD system shall indicate the failure of any powertrain fault that triggers an operation mode that significantly reduces torque in comparison with normal operation.

3.3. The test type I data in the template for a test report according to the template set out in UN GTR No. 2, including the used dynamometer settings and applicable emission laboratory test cycle, shall be provided for reference.

3.4. The list with PCU / ECU malfunctions shall be provided:

3.4.1. For each malfunction that leads to the OBD threshold limits, in both non-defaulted and defaulted driving mode being exceeded. The emission laboratory test results shall be reported in those additional columns in the format of the information document referred to in Annex 8;

3.4.2. For short descriptions of the test methods used to simulate the emission-relevant malfunctions, as referred to in paragraph 4.

4. OBD environmental test procedure

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

4.1.1. Simulation of malfunction of a component of the powertrain management or emission-control system;

4.1.2. Preconditioning of the vehicle (in addition to the preconditioning specified in UN GTR No. 2) with a simulated malfunction that will lead to the OBD threshold limits in paragraph 5.5.1. of general requirements being exceeded.

4.1.3. Driving the vehicle with a simulated malfunction over the applicable type I test cycle and measuring the tailpipe emissions of the vehicle;

4.1.4. Determining whether the OBD system reacts to the simulated malfunction and alerts the vehicle driver to it in an appropriate manner.

4.2. Alternatively, at the request of the manufacturer, malfunction of one or more components may be electronically simulated in accordance with the requirements laid down in paragraph 8.

4.3. Manufacturers may request that monitoring take place outside the type I test cycle if it can be demonstrated to the approval authority that the monitoring conditions of the type I test cycle would be restrictive when the vehicle is used in service.

4.4. For all demonstration testing, the Malfunction Indicator (MI) shall be activated before the end of the test cycle.

5. Test Vehicle and Test Fuel

5.1. Test Vehicle

The test vehicles shall meet the requirements of UN GTR No. 2. The manufacturer shall set the system or component for which detection is to be demonstrated at or beyond the criteria limit prior to operating the vehicle over the emissions test cycle appropriate for the classification of the vehicle. To determine correct functionality of the diagnostic system, the test vehicle shall then be operated over the appropriate type I test cycle according to its classification set out in UN GTR No. 2.

5.2. Test fuel

The reference fuel to test the vehicle shall be specified by the Contracting Party and be of the same specification as the reference fuel used to conduct the type I tailpipe emissions after cold start. The selected fuel type shall not be changed during any of the test phases.

6. Test temperature and pressure

6.1. The test temperature and ambient pressure shall meet the requirements of the type I test as set out in UN GTR No. 2.

7. Test equipment

Chassis dynamometer

7.1. The chassis dynamometer shall meet the requirements of UN GTR No. 2.

8. OBD environmental verification test procedures

8.1. The operating test cycle on the chassis dynamometer shall meet the requirements of UN GTR No. 2.

8.1.1. The Type I test need not be performed for the demonstration of electrical failures (short/open circuit). The manufacturer may demonstrate these failure modes using driving conditions in which the component is used and the monitoring conditions are encountered. Those conditions shall be documented in the approval documentation.

8.2. Vehicle preconditioning

8.2.1. According to the propulsion type and after introduction of one of the failure modes referred to in paragraph 8.3., the vehicle shall be preconditioned by driving at least two consecutive appropriate type I tests. For vehicles equipped with a compression ignition engine, additional preconditioning of two appropriate type I test cycles is permitted.

8.2.2. At the request of the manufacturer, alternative preconditioning methods may be used.

8.2.3. The use of additional preconditioning cycles or alternative preconditioning methods shall be documented in the approval documentation.

8.3. Failure modes to be tested

8.3.1. For positive-ignition propelled vehicles:

8.3.1.1. Replacement of the catalytic converter type with a deteriorated or defective catalytic converter or electronic simulation of such a failure, unless excluded from catalytic converter monitoring by application of paragraph 5.3.4.~~1.~~2. of the general requirements;

8.3.1.2. An induced misfire condition (i.e. by faulty component(s) or electronic simulation of such a failure) in line with those for misfire monitoring referred to in paragraph 5.3.4.~~2~~3. of general requirements that result in emission of any components exceeding any of the applicable OBD threshold limits given in paragraph 5.5.1. of general requirements.

8.3.1.3. Replacement of the oxygen sensor with a deteriorated or defective sensor or electronic simulation of such a failure;

8.3.1.4. Electrical disconnection of any other emission-related component connected to a powertrain control unit / engine control unit in the scope of Annex 2;

8.3.1.5. Electrical disconnection of the electronic evaporative purge control device (if equipped). For this specific failure mode, the type I test need not be performed.

8.3.2. For vehicles equipped with a compression-ignition engine:

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8.3.2.1. Replacement of the catalytic converter type, where fitted, with a deteriorated or defective catalytic converter or electronic simulation of such a failure, unless excluded from catalytic converter monitoring by application of paragraph 5.3.5. ~~1.~~2. of the general requirements;

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8.3.2.2. Total removal of the particulate filter, where fitted, or, where sensors are an integral part of the filter, a defective filter assembly;

8.3.2.3. Electrical disconnection or shorted circuit of any electronic fuel quantity and timing actuator in the fuelling system;

8.3.2.4. a) Electrical disconnection of any other emission-related component connected to any control unit of the powertrain, the propulsion units or the drive train;

b) A Contracting Party may require in addition that electrical disconnection of any other functional safety-relevant component connected to any control unit of the powertrain, the propulsion units or the drive train;

8.3.2.5. The manufacturer shall take appropriate steps to demonstrate that the OBD system will indicate a fault when one or more of the faults occur listed in Annex 2.

8.3.3. The manufacturer shall demonstrate that malfunctions of the EGR flow and cooler, where fitted, are detected by the OBD system during its approval test.

8.3.4. A Contracting Party may require that any powertrain malfunction that triggers any operating mode which significantly reduces engine torque (i.e. by 10 % or more in normal operation) shall be detected and reported by the powertrain / engine control system.

8.4. OBD system environmental verification tests

8.4.1. Vehicles fitted with positive-ignition engines:

After vehicle preconditioning in accordance with paragraph 8.2., the test vehicle is driven over the appropriate type I test.

8.4.1.1. The malfunction indicator shall activate before the end of this test under any of the conditions given in paragraphs 8.4.1.2. to 8.4.1.6. The MI may also be activated during preconditioning. The approval authority may substitute those conditions with others in accordance with paragraph 8.4.1.6. However, the total number of failures simulated shall not exceed four for the purpose of type-approval.

8.4.1.2. Replacement of a catalytic converter type with a deteriorated or defective catalytic converter or electronic simulation of a deteriorated or defective catalytic converter that results in emissions exceeding the THC OBD threshold limit~~,~~ or, if applicable, the NMHC OBD threshold limit, in paragraph 5.5.1. of general requirements, unless excluded from catalytic converter monitoring by application of paragraph 5.3.4. ~~1.~~2. of the general requirements;

Commented [DL25]:

8.4.1.3. An induced misfire condition in line with those for misfire monitoring referred to in paragraph 5.3.4.~~2~~3. of general requirements that results in emissions of any components exceeding any of the applicable OBD threshold limits given in paragraph 5.5.1. of general requirements;

8.4.1.4. 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 OBD threshold limits in paragraph 5.5.1. of general requirements;

8.4.1.5. Electrical disconnection of the electronic evaporative purge control device (if equipped);

8.4.1.6. a) Electrical disconnection of any other emission-related powertrain component connected to a powertrain control unit / engine control unit / drive train control unit that results in emissions exceeding any of the OBD threshold limits in paragraph 5.5.1. of general requirements.

b) A Contracting Party may require in addition that triggers an operation mode with significantly reduced torque as compared with normal operation.

8.4.2. Vehicles fitted with compression-ignition engines.

8.4.2.1. After vehicle preconditioning in accordance with paragraph 8.2., the test vehicle is driven in the applicable type I test.

The malfunction indicator shall activate before the end of this test under any of the conditions in paragraphs 8.4.2.2. to 8.4.2.5. The approval authority may substitute those conditions by others in accordance with paragraph 8.4.2.5. However, the total number of failures simulated shall not exceed four for the purposes of type-approval;

8.4.2.2. Replacement of a catalytic converter type, where fitted, with a deteriorated or defective catalytic converter or electronic simulation of a deteriorated or defective catalytic converter that results in emissions exceeding any of the OBD threshold limits in paragraph 5.5.1. of general requirements, unless excluded from catalytic converter monitoring by application of paragraph 5.3.5. 1.2 of the general requirements;

8.4.2.3. Total removal of the particulate filter, where fitted, or replacement of the particulate filter with a defective particulate filter meeting the conditions laid down in [paragraph 8.4.2.2.] that results in emissions exceeding any of the OBD threshold limits in paragraph 5.5.1. of general requirements.

8.4.2.4. With reference to paragraph 8.3.2.5., disconnection of any electronic fuel quantity and timing actuator in the fuelling system that results in emissions of any components exceeding any of the applicable OBD threshold limits in paragraph 5.5.1. of general requirements;

8.4.2.5. a) With reference to paragraph 8.3.2.4., disconnection of any other powertrain component connected to a powertrain control unit / engine control / drive train control unit that results in emissions of any components exceeding any of the applicable OBD threshold limits in paragraph 5.5.1. of general requirements.

b) A Contracting Party may require in addition that disconnection of any other powertrain component connected to a powertrain control unit / engine control / drive train control unit that results in triggering of an operation mode with a significantly reduced torque as compared with normal operation.

8.4.3. Replacement of the NOx after-treatment system, where fitted, with a deteriorated or defective system or electronic simulation of such a failure.

8.4.4. Replacement of the particulate matter monitoring system, where fitted, with a deteriorated or defective system or electronic simulation of such a failure.

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Annex 7 Propulsion unit family definition with regard to on-board diagnostics

1. A vehicle in the scope of this UN GTR may continue to be regarded as belonging to the same vehicle propulsion family with regard to on-board diagnostics provided that the vehicle parameters in Table A7/1 or vehicle parameters referred to in Annex 5 are identical and remain within the prescribed and declared tolerances.

2. A representative parent vehicle shall be selected within the boundaries set by the classification criteria laid down in Table A7/1 or vehicle parameters referred to in Annex 5.

The following propulsion family classification criteria shall apply:

Table A7/1: Classification criteria propulsion family with regard to on-board diagnostics

No.	*Classification criteria description*	
1.	**Vehicle**	
1.1.	category; Note: Two-wheeled motorcycles and two-wheeled motorcycles with sidecars are considered to be of the same family.	X
1.2.	sub-category;	X
1.3.	the inertia of a vehicle variant(s) or version(s) within two inertia categories above or below the nominal inertia category;	X
1.4.	overall gear ratios (+/- 8%).	X
2.	**Propulsion family characteristics**	
2.1.	number of engines;	X
2.2.	number of cylinders of the combustion engine;	X
2.3.	engine capacity (+/- 30 %) of the combustion engine;	X
2.4.	number and control (variable cam phasing or lift) of combustion engine valves;	X
2.5.	fuel system (carburettor / scavenging port / port fuel injection / direct fuel injection / common rail / pump-injector / other);	X
2.6.	type of cooling system of combustion engine;	X
2.7.	combustion cycle (PI / CI / two-stroke / four-stroke / other);	X

No.	*Classification criteria description*	
2.8.	intake air system (naturally aspirated / charged (turbocharger / super-charger) / intercooler / boost control) and air induction control (mechanical throttle / electronic throttle control / no throttle).	X
3.	**Pollution control system characteristics**	
3.1.	operation principle of cold start or starting aid device(s);	X
3.2.	activation time of cold-start or starting aid device(s) and /or duty cycle (only limited time activated after cold start / continuous operation);	X
3.3.	propulsion unit (not) equipped with O_2 sensor for fuel control;	X
3.4.	O_2 exhaust sensor type(s);	X
3.5.	operation principle of O_2 exhaust sensor (binary / wide range / other);	X
3.6.	O_2 exhaust sensor interaction with closed-loop fuelling system (stoichiometry / lean or rich operation).	X

Annex 8 Administrative provisions

1. The vehicle manufacturer shall fill out the information and submit to the approval authority with regard to functional on-board diagnostics and test type VIII according to the following template.

1.1. Where documents, diagrams or long descriptions are required the vehicle manufacturer shall attach those as a separate file, appropriately marked in a clear and understandable system and the marking shall be written/typed for all sheets in the space provided.

1.2. The following data shall be provided by the vehicle manufacturer:

1.2.1. On-board diagnostics (OBD) functional requirements

1.2.1.1. OBD system general information

1.2.1.1.1. Written description and/or drawing of the malfunction indicator (MI):

1.2.1.1.2. List and purpose of all components monitored by the OBD system:

1.2.1.1.3. Written description (general working principles) for all OBD circuit (open circuit, shorted low and high, rationality) and electronics (PCU/ECU internal and communication) diagnostics:

1.2.1.1.4. Written description (general working principles) for all diagnostic functionality triggering any operating mode which significantly reduces engine torque in case of fault detection:

1.2.1.1.5. Written description of the communication protocol(s) supported:

1.2.1.1.6. Physical location of diagnostic-connector (add drawings and photographs):

1.2.1.1.7. Written description in case of compliance with OBD (general working principles):

1.2.1.1.7.1. Positive-ignition engines

1.2.1.1.7.1.1. Catalyst monitoring:

1.2.1.1.7.1.2. Misfire detection:

1.2.1.1.7.1.3. Oxygen sensor monitoring:
1.2.1.1.7.1.4. Other components monitored by the OBD system:
1.2.1.1.7.2. Compression-ignition engines
1.2.1.1.7.2.1. Catalyst monitoring:
1.2.1.1.7.2.2. Particulate filter monitoring:
1.2.1.1.7.2.3. Electronic fuelling system monitoring:
1.2.1.1.7.2.4. deNOx system monitoring:
1.2.1.1.7.2.5. Other components than the ones listed in Table A2/2 of Annex 2 ~~(Table A2/2)~~ monitored by the OBD system;
1.2.1.1.7.3. Criteria for MI activation (fixed number of driving cycles or statistical method):
1.2.1.1.7.4. List of all OBD output codes and formats used (with explanation of each):
1.2.1.2. OBD compatibility for repair information
1.2.1.2.1 The following additional information shall be provided by the vehicle manufacturer to enable the manufacture of OBD-compatible replacement or service parts, diagnostic tools and test equipment:
1.2.1.2.2. A description of the type and number of the pre-conditioning cycles used for the original approval of the vehicle;
1.2.1.2.3. A comprehensive document describing all sensed components concerned with the strategy for fault detection and MI activation (fixed number of driving cycles or statistical method). This shall, include a list of relevant secondary sensed parameters for each component monitored by the OBD system. The document shall also list all OBD output codes and formats (with an explanation of each) used in association with individual emission-related powertrain components and individual non-emission- related components, where monitoring the component is used to determine MI activation. This shall contain, in particular, a comprehensive explanation for the data given in service $05 Test ID $ 21 to FF and the data given in service $06:

1.2.1.2.4. The information required above may be provided in table form as described below.

Table A8/1 Example OBD fault-code overview list

Component	*Diagnostic trouble code*	*Monitoring strategy*	*Fault detection criteria*	*MI activation criteria*	*Secondary parameters*	*Preconditioning*	*Demonstration test*
Intake air temp. sensor open circuit	P0xx xxzz	Comparison with temperature model after cold start	> 20 degrees difference between measured and modelled intake air temperature	3rd cycle	Coolant and intake air temperature sensor signals	Two type I cycles	Type I if Contracting Party applies MI performance criteria

1.2.1.2.5 Description of electronic throttle control (ETC) diagnostic fault codes

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1.2.1.3. Communication protocol information

1.2.1.3.1. The following information shall be referenced to a specific vehicle make, model and variant, or identified using other workable definitions such as VIN or vehicle and systems identification:

1.2.1.3.2. Any protocol information system needed to enable complete diagnostics in addition to the standards prescribed in paragraph 3.8. of Annex 1., such as additional hardware or software protocol information, parameter identification, transfer functions, "keep alive" requirements, or error conditions;

1.2.1.3.3. Details of how to obtain and interpret all diagnostic trouble codes not in accordance with the standards prescribed in paragraph 3.11. of Annex 1;

1.2.1.3.4. A list of all available live data parameters including scaling and access information;

1.2.1.3.5. A list of all available functional tests including device activation or control and the means to implement them;

1.2.1.3.6. Details of how to obtain all component and status information, time stamps, pending DTC and freeze frames;

1.2.1.3.7. PCU/ECU identification and variant coding;

1.2.1.3.8. Details of how to reset service lights;

1.2.1.3.9. Location of diagnostic connector and connector details;

1.2.1.3.10. Engine code identification.

1.2.1.4. Test and diagnosis of OBD monitored components

1.2.1.4.1. A description of tests to confirm its functionality, at the component or in the harness

1.2.2. On-board diagnostics environmental test type VIII requirements

1.2.2.1. Details of test vehicle(s), its powertrain and pollution-control devices explicitly documented and listed, emission test laboratory equipment and settings.

1.2.2.1.1. The manufacturer shall enter the emission laboratory test type VIII results TR TTVIIIx in the table~~s~~ below (both in mg/km and in % of ~~TR~~ ~~TTVIIIx~~OTx):

Test type VIII OBD environmental results

Table ~~A8-1~~A8/2~~1~~ OBD thresholds limits 1 (OTL1) and environmental test results in case of malfunction

Commented [DL30]: Editorial correction

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Propulsion class	OBD Thresholds (OT x) / OBD Test results (TR TTVIIIx) x = 1 to 3	Mass of carbon monoxide (CO)	Mass of total hydrocarbons (THC)	Mass of oxides of nitrogen (NOx)
PI / PI Hybrid v max < 130 km/h	OT_x (mg / km)	OT_1 : 2 170	OT_2 : 1 400	OT_3 : 350
	$OTR_{TTVIIIx}$ (mg / km) & (% of OT x)	$TR_{TTVIII1}$:	$TR_{TTVIII2}$:	$TR_{TTVIII3}$:
PI / PI Hybrid v max ≥ 130 km/h	OT_x (mg / km)	OT_1 : 2 170	OT_2 : 630	OT_3 : 450
	$OTR_{TTVIIIx}$ (mg / km) & (% of OT x)	$TR_{TTVIII1}$:	$TR_{TTVIII2}$:	$TR_{TTVIII3}$:
CI / CI Hybrid	OT x (mg / km)	OT_1 : 2 170	OT_2 : 630	OT_3 : 900
	$OTR_{TTVIIIx}$ (mg / km) & (% of OT x)	$TR_{TTVIII1}$:	$TR_{TTVIII2}$:	$TR_{TTVIII3}$:

Table ~~A8-2~~A8/23

OBD threshold limits 2 (OTL2) and environmental test results in case of malfunction

Propulsion class	OBD Thresholds (OT x) / OBD test results (TR TTVIIIx) x = 1 to 3 4	Mass of carbon-monoxide (CO)	Mass of non-methane hydrocar-bons (NMHC)	Mass of oxides of nitrogen (NOx)	Mass of particulate matter (PM)
PI / PI Hybrid	OT_x (mg / km)	OT_1 : 1 900	OT_2 : 250	OT_3 : 300	OT_4 : 50
	$OTR_{TTVIIIx}$ (mg / km) & (% of OT x)	$TR_{TTVIII1}$:	$TR_{TTVIII2}$:	$TR_{TTVIII3}$:	$TR_{TTVIII4}$
CI / CI Hybrid	OT_x (mg / km)	OT_1 : 1 900	OT_2 : 320	OT_3 : 540	OT_4 : 50
	$OTR_{TTVIIIx}$ (mg / km) & (% of OT x)	$TR_{TTVIII1}$:	$TR_{TTVIII2}$:	$TR_{TTVIII3}$:	$TR_{TTVIII4}$

1.2.2.1.2. Contracting Parties may require the alternative OBD emission threshold according to their limit value of tailpipe emission legislation.

Commented [DL32]: Correction 2020-06-10.
table text “x=1 to 3”
to be changed into “x=1 to 4”