

This informal document is submitted by the **Informal Working Group (IWG) on Environmental and Propulsion Performance Requirements of L-category vehicles (EPPR)** to inform and update the GRPE of the work of the IWG on the amendment of UN GTR 18 to include OBD 2.

This is the consolidated document addressing the phase 1 of the work of the IWG and in particular of the work of the Correspondent Group as defined by the IWG in its formation (EPPR-24 and its term of reference<sup>1</sup>)

*Draft*

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<sup>1</sup> <https://wiki.unece.org/display/trans/OBD2+ToR>

## 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].

### 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

<i>Propulsion unit and fuel type</i>			<i>Functional OBD</i>	<i>Test type VIII</i>
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].

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- 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 [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. *"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.
- 3.19. *"Power take-off unit"* means an engine-driven output provision for the purposes of powering auxiliary, vehicle-mounted equipment;
- 3.20. *"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.
- 3.21. *"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.
- 3.22. *"Significant reduction of propulsion torque"* means a propulsion torque less than or equal to 90 % of torque in normal operation mode;
- 3.23. *"Software calibration identification (CAL ID)"* means a series of alphanumeric characters that identify the emission-related calibration and/or software version.
- 3.24. *"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.
- 3.25. *"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.
- 3.26. *"Useful life"* means the relevant period of distance and/or time over which compliance with the OBD system has to be assured.
- 3.27. *"Vehicle type"* means a category of power-driven vehicles which do not differ in essential engine/vehicle and OBD system characteristics.
- 3.28. *"Warm-up cycle" for category 3 vehicle\** means sufficient vehicle operation such that the coolant temperature rises by at least 22 °C 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] - Placeholder**

### **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 5.3.7., 5.3.8. and 5.3.1.], 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].

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

The reduction in the efficiency of the catalytic converter with respect to emissions of hydrocarbons and nitrogen oxides. 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 in [paragraph 5.5.1].

5.3.4.2. 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 2500 min<sup>-1</sup> or normal idle speed +1000 min<sup>-1</sup>, whichever is the lower

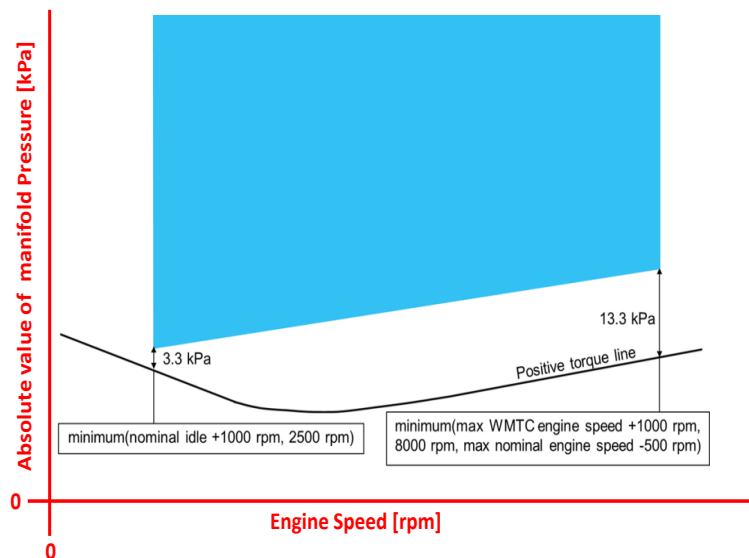
(b) high speed limit: A maximum speed of 8000 min<sup>-1</sup> or 1000 min<sup>-1</sup> greater than the highest speed occurring during a type I test cycle or maximum design engine speed minus 500 min<sup>-1</sup>, whichever is lower

(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 10-1].



[Figure 10-1] Operating region for misfire detection

#### 5.3.4.3. 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. The electronic evaporative emission purge control shall, at a minimum, be monitored for circuit continuity.

#### 5.3.4.5. 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. Reduction in the efficiency of the catalytic converter, where fitted;

#### 5.3.5.2. The functionality and integrity of the particulate trap, where fitted.

#### 5.3.5.3. 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. Malfunctions and the reduction in efficiency of the EGR system, shall be monitored.

#### 5.3.5.5. Malfunctions and the reduction in efficiency of a NO<sub>x</sub> after-treatment system using a reagent and the reagent dosing subsystem shall be monitored.

#### 5.3.5.6. Malfunctions and the reduction in efficiency of NO<sub>x</sub> 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], 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], 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 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.
- 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.].
- 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. and 5.3.4.3.] for positive-ignition engines and [paragraph 5.3.5.1., 5.3.5.2. and 5.3.5.3.] for compression-ignition engines shall be identified first.
- 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 1 in Annex 7] or [table XX of 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	NO <sub>x</sub>	PM
<b>OTL 1 Principal</b>	<b>PI Class 1/2</b>	2170	1400	-	350	-
	<b>PI Class 3</b>	2170	630	-	450	-
	<b>CI</b>	2170	630	-	900	-
<b>OTL 2 Enhanced</b>	<b>PI</b>	1900	-	250	300	50
	<b>CI</b>	1900	-	320	540	50

- 5.5.2. [Contracting parties shall introduce OTL 2 after the introduction of OTL 1. Contracting parties shall set appropriate period for OTL 1 before introducing OTL 2.]
- [Contracting parties may either introduce OTL 2 directly or after the introduction of OTL 1.]

- 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 1 of Annex 7] or [table XX of 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.

## 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 [paragraph 5.3.10.1.] 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:

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

- 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 x.y.z.] 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. Access to OBD information and IUPR]

## **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 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 1: Overview of devices (if fitted) to be monitored in OBD

No.	Device circuits	Level, refer to 2.3.	Circuit continuity			Circuit rationality			Basic monitoring requirement	Comment No.
			Circuit High	Circuit Low	Open Circuit	Out of Range	Performance / Plausibility	Signal stuck		
1	Control module (ECU / PCU) internal error	3							Yes	(1)
<b>Sensor (input to control units)</b>										
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)

No.	Device circuits	Level, refer to 2.3.	Circuit continuity			Circuit rationality			Basic monitoring requirement	Comment No.
			Circuit High	Circuit Low	Open Circuit	Out of Range	Performance / Plausibility	Signal stuck	Device not operational / Device not present	
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)
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 <sub>2</sub> 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)

.No.	Device circuits	Level, refer to 2.3.	Circuit continuity			Circuit rationality			Basic monitoring requirement	Comment No.
			Circuit High	Circuit Low	Open Circuit	Out of Range	Performance / Plausibility	Signal stuck	Device not operational / Device not present	
<b>Actuators (output control units)</b>										
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 <sub>2</sub> 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 1], 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 1] may be exempted from test type VIII emission verification tests referred to in [Annex 3] 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 1] 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 1] 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 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 set-out in [section B.4. of Revision 1 of UN GTR No 2] using the test procedures set-out in this Annex and in the applicable World-harmonised Motorcycle Test Cycle (WMTC) set out in section B.2. of 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 type 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 type 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 type 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;
  - 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.] 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:
  - 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;
  - 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;
- 8.4.1.3. An induced misfire condition in line with those for misfire monitoring referred to in [paragraph 5.3.4.2.] 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;
- 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 NO<sub>x</sub> 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.

## 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 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 1 of Annex 7 or table XX of annex 5]

The following propulsion family classification criteria shall apply:

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

<i>No.</i>	<i>Classification criteria description</i>	
<b>1.</b>	<b>Vehicle</b>	
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

<i>No.</i>	<i>Classification criteria description</i>	
<b>2.</b>	<b>Propulsion family characteristics</b>	
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
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
<b>3.</b>	<b>Pollution control system characteristics</b>	
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 <sub>2</sub> sensor for fuel control;	X
3.4.	O <sub>2</sub> exhaust sensor type(s);	X
3.5.	operation principle of O <sub>2</sub> exhaust sensor (binary / wide range / other);	X
3.6.	O <sub>2</sub> exhaust sensor interaction with closed-loop fuelling system (stoichiometry / lean or rich operation).	X