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PROPOSAL FOR NEW DRAFT GLOBAL TECHNICAL REGULATION (gtr)

UNIFORM PROVISIONS CONCERNING THE TECHNICAL REQUIREMENTS FOR ON-BOARD DIAGNOSTIC SYSTEMS (OBD) FOR ROAD VEHICLES

Transmitted by the Chairman of the World-Wide Harmonized Heavy-Duty OBD group (WWH-OBD)

Note: The text reproduced below was prepared by the GRPE informal group on WWH-OBD. This document is the draft global technical regulation (gtr) to establish technical requirements for on-board diagnostic systems (OBD) for road vehicles

Paragraphs for which no agreement has been reached by the GRPE informal working group in charge of drafting the present document are highlighted in light grey.

Note: This document is distributed to the Experts on Pollution and Energy only.

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PART A:

JUSTIFICATION AND TECHNICAL RATIONALE

1. INTRODUCTION

This global technical regulation (gtr) establishes technical requirements for on-board diagnostic systems (OBD) for road vehicles. Currently, the gtr is directed only at OBD requirements for heavy-duty engines/vehicles necessary to maintain emissions-related performance (i.e., emissions-OBD). 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 in the future.

In brief, the gtr sets forth OBD performance requirements to which engine manufacturers must demonstrate compliance to certification authorities. The gtr also sets forth a basic set of demonstration requirements for manufacturers so that compliance can be demonstrated in a consistent manner. Also included are requirements to standardise the communication of on-board information to off-board devices to assist in maintenance of the increasingly complex modern diesel engines, and to facilitate the future use of OBD as a roadworthiness indicator for heavy-duty vehicles.

Of particular importance with respect to the use of OBD as a roadworthiness indicator is the introduction, with this gtr, of a failure severity indication via the dashboard malfunction warning signal (malfunction indicator). The failure severity indication is achieved in two ways. Firstly, the gtr requires the use of a separate and dedicated malfunction indicator to indicate a malfunction in the engine and emissions control system that results in an increase in emissions. Other failures that previously may have been communicated via a shared indicator must now use a separate and discreet indicator. Secondly, the gtr requires that the effect of malfunctions be assessed as part of the design function and that their effect be designated to a specific level within a 3-tier classification. Upon malfunction detection, the malfunction indicator is required to communicate in a unique way depending on which of the three tiers to which the detected malfunction has been designated. While the requirements for the malfunction indicator provide for each of these failure levels to be discernible, only the upper two failure levels are automatically indicated to the driver. This has been termed a "discriminatory display" strategy as it discriminates between three possible severities of malfunctions when indicating them via the malfunction indicator. This new requirement is intended to allow vehicle operators, maintenance staff, inspectors and enforcement authorities to make an informed decision with regard the roadworthiness of the vehicle. Nevertheless, not all Contracting Parties may wish to apply this approach. Therefore, the gtr provides for a malfunction indicator that would use a non-discriminatory display strategy (i.e., one that would communicate all malfunctions regardless of their severity in the same manner via the malfunction indicator) for regions that may find it more suitable than this new discriminatory display model.

The gtr recognizes that it is not always possible to know precisely the impact of a failure or deterioration of a system or its component parts on the actual emissions from the vehicle. Therefore, the gtr minimizes the burden on the manufacturer in this regard by allowing the classification of malfunctions to be achieved, as far as is reasonable, by engineering analyses. Inevitably, certification authorities will require validation of the engineering analyses and, therefore, the gtr provides for testing using deteriorated components to assess the OBD system performance. The gtr does not

require testing to determine whether malfunctions should be placed in a lower level in the classification than that proposed by the manufacturer at the time of certification or type approval. However, the expectation is that manufacturers will apply best practice to achieve correct classification of malfunctions and evidence of this effort will be assessed, in part, from the engineering analyses provided as part of the certification process. Where experience or testing in the market indicates a significant malfunction misclassification, the gtr provides for its re-classification (paragraph A.5., below, refers to the recommended administrative procedures for global technical regulations in such cases of reclassification).

Recent years have seen a rapid increase in the number of vehicle functions that depend upon the use of electrical/electronic control. This trend is expected to continue. Further, the emissions control systems on highway vehicles are not the only systems for which OBD capability is important. Vehicle systems provided to manage or deliver safety control are also equipped with diagnostic capability. Recognising this fact, and the negative implications that non-standardised diagnostics can have on maintenance and inspection procedures, this gtr has been structured such that further OBD functionality — e.g. OBD for safety related systems — could be added in the future as and when appropriate. This flexible structure is represented in two ways within this gtr. Firstly, a generic paragraph (Module A) is provided that sets out key definitions and functions to be applied to all OBD systems considered by this gtr. In developing Module A, the current regulatory requirements for failure identification and warning in both the field of emissions control and safety system management have been considered. Secondly, the gtr refers to particular work of the International Organization for Standardization (ISO) with respect to their work on a new standard "Road Vehicles – On board diagnostics (WWH-OBD) implementation", that considers the application of OBD beyond emissions control systems. By taking this approach, the intention is that future regulatory activity concerning OBD systems for all fields of road vehicle technology will deliver compatible requirements that provide a common feel for the user, be they the vehicle operator, the maintenance technician, the inspector, or the enforcement authority.

Given the flexible structure of the gtr, any future OBD working group developing requirements to add a new OBD functionality would simply need to add a new paragraph - termed modules - to the gtr that would address the specific OBD requirements of interest. Such a working group would also be required to review Module A of the gtr and, perhaps, revise it appropriately to ensure that there are no conflicting requirements or definitions. Further, Module B "Emission-Related Heavy-Duty Diesel OBD" should not require revision by any such future working group. Also of note is the use of parallel paragraph numbering between Modules A and B where possible. Future working groups are encouraged to follow this precedent.

It is important to note that many of the elements that have been developed for emissions-related OBD systems can be applicable to other types of OBD functionalities. For example, while the provisions for indicating the severity of malfunctions via the malfunction indicator have been developed as being specific to the emissions control system, the approach is fully consistent with failure warning provided for some safety systems today and would be easily developed as appropriate when additional OBD requirements might be considered.

OBD is likely to become increasingly important in future roadworthiness/inspection and maintenance procedures and the gtr reflects this expectation. It provides for standardized OBD data to be accessible from a common OBD access port. Telematic functions are being offered

increasingly to improve the efficiency of working vehicles and, whilst this functionality is not included in the current version of the gtr, it nonetheless anticipates such a possible future need. The work of ISO is such that, should there be a future political or commercial need for this technology, the impact on the design of the OBD systems, and on manufacturing industry, will be minimized.

2. PROCEDURAL BACKGROUND

During the one-hundred-and-twenty-sixth session of WP.29 of March 2002, the Executive Committee (AC.3) of the 1998 Global Agreement (1998 Agreement) adopted a programme of work, which includes the development of a global technical regulation (gtr) concerning onboard diagnostic systems for heavy-duty vehicles and engines.

An informal working group – the WWH-OBD working group – was actually established in September 2001, further to a proposal from the GRPE Chair in May 2001, to incorporate heavy-duty OBD into the GRPE agenda. Japan volunteered to lead the group.

The working group was instructed that the OBD system should detect failures from the engine itself, as well as from the exhaust after-treatment systems fitted downstream of the engine, and from the package of information exchanged between the engine electronic control unit(s) and the rest of vehicle and/or powertrain.

The working group was also instructed to base the OBD requirements on the technologies expected to be industrially available at the time the gtr would be enforced, and to take into account both the expected state of electronics in the years 2005-2008 and the expected newest engine and after-treatment technologies.

In November 2003, AC.3 further directed the working group to structure the gtr in such a manner as to enable its future extension to other functions of the vehicle. In so doing, AC.3 did not revise the scope of the task given to the working group (i.e., the scope remained emissions-related heavy-duty OBD). Hence the structure of the gtr as described above.

3. EXISTING REGULATIONS, DIRECTIVES, AND INTERNATIONAL VOLUNTARY STANDARDS

3.1. Those pertaining to emissions-related OBD

In the United States of America:

40 CFR 86.005-17 and 40 CFR 86.1806-05 contain OBD requirements for vehicles and engines fitted in vehicles less than 14,000 pounds gross vehicle weight. 1/ These regulations with respect to heavy-duty engines and vehicles were implemented in the 2004 and 2005 model years. As of this writing, the U.S. Environmental Protection Agency is developing proposed OBD requirements to be implemented in the 2010 model year for engines fitted in vehicles over 14,000 pounds gross vehicle weight.

1/ See 58 FR 9468 and 65 FR 59896.

Also, 13 CCR 1968.2, 13 CCR 1971 and 13 CCR 1971.1 contain OBD requirements for California vehicles up to 14,000 pounds gross vehicle weight and engines fitted in vehicles over 14,000 pounds gross vehicle weight, respectively.

In Europe:

Directive 98/69/EC 2/ (amending Directive 70/220/EEC 3/) introduced, for the first time, emission-related OBD requirements applicable to petrol and diesel passenger cars and light-commercial vehicles (nominally up to 3.5 t gross vehicle mass). Table A.1 below gives the application dates of OBD to the vehicles covered by Directive 70/220/EEC.

Directive 1999/102/EC 4/ introduced, amongst other things, revised provisions for misfire monitoring, adoption of the CAN protocol and provisions for deficiencies. These requirements applied from the same dates as given in Directive 98/69/EC.

Directive 2001/1/EC 5/ introduced OBD requirements for vehicles running permanently or part-time on liquid petroleum gas (LPG) or natural gas (NG) fuel. Table A.1. gives the application dates of OBD to vehicles equipped with spark-ignition engines running permanently or part-time on liquefied petroleum gas (LPG) or natural gas (NG).

Directive 2002/80/EC 6/ introduced requirements for the type-approval of OBD-compatible replacement catalytic converters and improved information to third Parties involved in the manufacturer of spare parts and diagnostic tools. These requirements will apply from 1 January 2006 onwards.

2/ See Official Journal of the European Communities, L350, 28.12.1998, p.1.
3/ See Official Journal of the European Communities, L76, 6.4.1970, p1.
4/ See Official Journal of the European Communities, L334, 28.12.1999, p.43.
5/ See Official Journal of the European Communities, L35, 6.2.2001, p.34.
6/ See Official Journal of the European Communities, L291, 28.10.2002, p.20.

Table A.1.: Application dates of European OBD Directives

Vehicle category	Date from which all new vehicles shall be equipped with an OBD system complying with the requirements of Directive 70/220/EEC (as amended)
Spark-ignition (petrol) engines:	
Category M1 (i.e. passenger cars) ≤ 2,500 kg:	1 January 2001
Category N1 class 1 (i.e. goods vehicles ≤ 1,305 kg):	
Category M1 > 2,500 kg:	1 January 2002
Category N1 classes II and III (i.e. goods vehicles > 1,305 kg and ≤ 3,500 kg):	
Spark-ignition engines running permanently or part-time on LPG or NG:	
Category M1 ≤ 2,500 kg and Category N1 class I	1 January 2006
Category M1 > 2,500 kg and Category N1 classes II and III:	1 January 2007
Compression-ignition (diesel) engines:	
Category M1 ≤ 2,500 kg and those designed to carry ≤ 6 occupants:	1 January 2004
Category M1 designed to carry > 6 occupants:	1 January 2006
Category N1 class 1:	
Category M1 > 2,500 kg:	1 January 2007
Category N1 classes II and III:	

Directive 1999/96/EC 7/ (amending Directive 88/77/EEC 8/) laid down the Euro 3, Euro 4 and Euro 5 pollutant emission limits. Article 4 of that Directive required the European Commission to bring forward a proposal to introduce OBD for heavy-duty vehicles and engines in parallel with the Euro 4 stage of emission limits. In response to this request, Directive 2005/55/EC 9/ lays down the fundamental elements relating to OBD for heavy-duty vehicles and engines, i.e. the formal structure of the requirements and the OBD threshold limits. This is complemented by Directive 2005/78/EC 10/ which provides the technical requirements for implementing the fundamental requirements of Directive 2005/55/EC.

In Japan:

Safety Regulations for Road Vehicles, Article 31 (Emission Control Device), Attachment 48 Technical Standard for On-Board Diagnostic (OBD) System for Exhaust Emission Control Devices

7/ See Official Journal of the European Communities, L44, 16.2.2000, p.1.
8/ See Official Journal of the European Communities, L36, 9.2.1988, p.33.
9/ See Official Journal of the European Communities, L275, 20.10.2005, p.1.
10/ See Official Journal of the European Communities, L313, 29.11.2005, p.1.[…].

for Motor Vehicles.

Amendments of the Technical Standard relating to the Safety Regulations for Road Vehicles (see Table A.2.):

- mandatory installation of an OBD system that monitors malfunctions caused by open circuits for gasoline- or liquefied petroleum gas-fuelled ordinary-sized motor vehicles, small-sized motor vehicles and mini-sized motor vehicles (1998).

- mandatory installation of an OBD system that monitors malfunctions caused by open circuits for diesel-fuelled ordinary-sized motor vehicles and small-sized motor vehicles (2000).

Table A.2.: Application date of Japanese OBD Technical Standard

Category	Date of application
Spark-ignition (gasoline- or liquefied petroleum gas) engines:	
GVW ≤ 3,500 kg:	1 October 2000
3,500 kg < GVW:	
Compression-ignition (diesel- fueled) engines:	
GVW ≤ 3,500 kg:	1 October 2003
3,500 kg < GVW:	

4. TECHNICAL RATIONALE, ECONOMIC IMPACTS, AND ANTICIPATED BENEFITS FOR THE EMISSIONS-RELATED OBD MODULE

4.1. Technical rationale

On-board diagnostic (OBD) systems are of interest to regulators for many reasons. The advent of electronic controls in the 1990s made the diagnosis of improperly operating engine systems and emissions control systems very difficult. Furthermore, the addition of exhaust gas recirculation (EGR) systems and exhaust after-treatment devices are expected to provide 50 to 99 per cent control of pollutant emissions. Without some form of onboard system capable of monitoring the performance of these devices for proper functioning, a driver could be completely unaware of a situation that might cause emissions to far exceed the applicable regulatory requirements.

Because computer and electronic systems are difficult to diagnose and repair when not functioning properly, most manufacturers of vehicles, trucks, and engines have incorporated on-board diagnostic (OBD) systems into their products. These OBD systems are capable of identifying improper functioning and help to pinpoint where the malfunction is occurring. This serves to inform both the driver of the vehicle that repair is needed, and the repairer of the vehicle what needs to be repaired. In the heavy truck industry, these OBD systems have been geared traditionally toward detecting problems that cause drivability and/or fuel economy related effects. Understandably, the primary objective of these systems has been to protect against performance problems that might result in customer dissatisfaction. The emissions-related OBD requirements in this gtr would build on the efforts already undertaken by industry to ensure that key emission related components will be monitored and that the diagnosis and repair of those components will be as efficient and cost effective as possible. The requirements of this gtr will ensure that malfunctions that are purely

emissions-related (i.e., those types of malfunctions that could result in high emissions without a corresponding adverse drivability or fuel economy impact) will be detected and communicated to the driver and the repair technician. The result being that the air quality benefits expected from the regulatory programs of the Contracting Parties will be fully realized.

An OBD system meeting the emissions-OBD requirements of this gtr would be expected to monitor the engine's electronic sensors and actuators and to monitor the exhaust after treatment devices for their proper operation. Upon detecting any problems, the driver would be notified of the need to seek repair and pertinent information would be stored in the engine computer for retrieval by the repair professional. As a result, emissions-related problems are identified, their presence is communicated to the driver, repair is sought out, and proper repair is completed.

Further, the malfunction classification of the gtr will provide roadworthiness inspectors with the ability to determine not only the presence of malfunctions but also the severity of their emissions impact. This will allow for certain regions, depending on their air quality needs, to impose repair requirements and/or fees for only those malfunctions meeting the appropriate severity. This is important since many malfunctions that will be detected by an OBD system meeting the requirements of this gtr will result in only minor emissions increases and may not cause emissions to exceed the regulated emissions limits.

4.2. Economic impacts

The requirements set forth in the emissions-related paragraph of the Regulation are believed to be technologically feasible in the timeframe expected for their implementation. The WWH-OBD working group consists of both regulators and industry representatives. General Agreement has been reached on the content of the gtr which should equate to general agreement on the feasibility of its requirements. Nonetheless, authorities are encouraged to carefully consider the costs, technological feasibility, fuel quality, and possible safety concerns that may be unique to their region when considering adoption of this gtr.

Designing and developing OBD systems that meet the emissions-OBD requirements of this gtr will cost industry considerable money. The cost of maintaining and repairing malfunctions identified by the OBD system will impact on industry, operators of heavy-duty vehicles and the general public. As noted in paragraph 3. above, many Contracting Parties have or are developing OBD requirements analogous to those in this gtr. Having one set of OBD requirements that would apply to all regions represented by the Contracting Parties would save industry considerable money relative to the situation they face currently with separate requirements in each region.

4.3. Anticipated benefits

The specific air quality benefits expected to arise in Contracting Parties that implement the emissions-OBD paragraph of this gtr will be unique to each region. However, in general, the expectation is that properly operating emissions control systems will result in cleaner air regardless of the region being considered. Any effort to ensure that emissions control systems will operate properly during their real world lifetime is of value.

Specific cost effectiveness values for this gtr have not been calculated. The decision by the Executive Committee of the 1998 Agreement to move forward with this gtr without specific

emissions threshold levels (i.e., the emissions level at which a malfunction is indicated) is the key reason why this analysis has not been completed. This agreement has been made knowing that specific cost effectiveness values are not immediately available. However, it is fully expected that this information will be developed, generally in response to the adoption of this gtr in the national or regional requirements of the Contracting Parties and also in support of developing harmonized limit values for the next step in this gtr's development. For example, each Contracting Party adopting this gtr into its national or regional regulations will be expected to determine the appropriate emissions threshold levels associated with these OBD requirements. Experience will be gained by industry as to any costs and savings associated with these world harmonized requirements. This cost and savings data and emissions performance data can then be analysed as part of the next step in this Regulation development to determine the cost effectiveness values of world harmonized OBD when matched with new harmonized limit values. While costs per tonne of pollutant reduced have not been calculated, the belief of the technical group is that there are clear benefits associated with this gtr.

5. ADMINISTRATIVE CONSIDERATIONS

There are some technical issues associated with this gtr that require provisions to be set out in the procedures for the general operation of global technical regulations.

Paragraph 4. of Module B of this gtr establishes the requirements for the case where a manufacturer may request to the certification authority that a malfunction(s) be reclassified from their original approved classifications, for example due to the discovery of an error in software coding or calibration.

For example, if an engine manufacturer determines through in-service testing, servicing information or other appropriate means that a malfunction or malfunctions should be re-classified, the manufacturer should make a specific request to the Contracting Party who granted the initial approval according to the rules or regulations applying this gtr in that Contracting Party. The manufacturer would provide details of the malfunction(s) in question, a technical justification for the re-classification(s), a list of the affected vehicle/engine families or types and the actions it will undertake to correct the classification(s). According to such information and if in agreement with such information, the Contracting Party would then simply extend the approval for the vehicle/engine families or types in question. It is recommended that, according to the general procedures for the operation of global technical regulations, the Contracting Party would inform other Contracting Parties to this gtr of the issue and any consequential actions it plans or has completed.

As an additional example, a certification authority in a Contracting Party may determine through in-service testing or any other regulatory measure applicable in the region in which that authority is responsible that, in the case of a vehicle/engine type or family which has been approved according to this gtr, a malfunction or malfunctions should be re-classified from their initial approved classification. In such a case, the Contracting Party would, where applicable, inform the manufacturer of the vehicle/engine type or family in question and undertake any applicable measures defined according to the rules or regulations applying this Regulation in that Contracting Party. If the Contracting Party undertakes any actions with the manufacturer in question, it is recommended

that the Contracting Party would inform other Contracting Parties to this global technical regulation of the issue and any consequential actions it plans or has completed. On that basis, other Contracting Parties might decide to require a manufacturer of the same vehicle/engine type or family to undertake a similar re-classification for those same vehicles/engines within that Contracting Party.

While these examples speak specifically to malfunction re-classification, similar examples could be given for other forms of post-approval fixes meant to correct elements of the OBD system that are not working as designed or as intended, whether they be identified by the certification authority or the manufacturer. For example, an OBD monitor that never operates - whether due to poor design, a software glitch, or some other unforeseen circumstances – in one Contracting Party would, presumably, not operate in other Contracting Parties. It is recommended that Contracting Parties inform other Contracting Parties to this gtr of such issues and any consequential actions it plans or has completed so that other Contracting Parties have the opportunity to consider the issue.

When considering adopting this gtr into its national or regional regulations, Contracting Parties are encouraged also to consider implementing specifications concerning

- the availability of service and repair information. Such information might include repair manuals, diagnostic tools, relevant computer software, training materials, or other special tools provided by engine manufacturers to their authorized dealer network. Such information is important to ensure that OBD identified malfunctions can be repaired by service personnel.

[text to be agreed by the Contracting Parties] :

- to the extent appropriate under national authority, the availability of OBD related information for verifying that replacement parts, which are critical to the correct functioning of the OBD system, are compatible with the vehicle OBD system.

6. POSSIBLE FUTURE EXTENSIONS OF THE GTR

6.1 Future extensions to other functions of the vehicle

As mentioned in paragraph 2, AC.3 directed the working group to structure the gtr in such a manner as to enable its future extension to other functions of the vehicle.
A modular structure has been adopted to achieve that requirement, where the scope and application of this gtr could be easily extended as summarised in the following table:

Application / Module	Diesel fuelled Heavy-Duty vehicles /engines	(Applicable for later purposes)
Module A Generic OBD requirements	YES	YES
Module B Exhaust emissions requirements	YES	

(Reserved for later purposes)		

Table A.1 - Possible extension of the scope and application of this gtr

6.2. Extension of the methods allowed for access to OBD information

Presently there exist two allowed communication protocols for the application of OBD to heavy-duty vehicles – ISO 15765-4 and SAE J1939-73. Both of these communication protocols are allowed in some existing Contracting Party regulations and both will exist in parallel for some period of time. But, in its meeting on 6-7 November 2002, the WWH-OBD group determined that the primary aim should be to have one common protocol for the presuming it would benefit all sectors operating under the umbrella of "the automotive industry".

Consequently, a sub-group of the WWH-OBD group drafted a set of general performance criteria that a common OBD communication protocol for heavy-duty vehicles should achieve relating to the needs of the legislator, the needs for inspection and maintenance and the needs of the repair technician, together with a draft timetable for completion of a common standard - this was transmitted to ISO TC22 SC3.

ISO standard 27415 is the result of the deliberations of ISO TC22 SC3. This standard contains prescriptions for wired on-board to off-board communications based on TCP/IP over Ethernet. TCP/IP over Ethernet provides industry with the benefit of higher communication speed and also lays the foundation for a possible move to wireless on-board to off-board communication at some point in the future in order to meet and be compatible with the road transport policy aims of some Contracting Parties.

As mentioned above, the worldwide heavy-duty vehicle industry presently applies both the ISO 15765-4 or SAE J1939-73 across their vehicle platforms. At this time, European heavy-duty vehicle OBD permits the use of either ISO 15765-4 or SAE J1939-73 but Directive 2005/78/EC states that the European Community will consider moving to the ISO 27415 standard when completed. In the United States, adopted and planned OBD regulations permit the use of either ISO 15765-4 or SAE J1939-73.

A vehicle communication platform is very complex and plays a role in nearly every aspect of the automotive industry from development, production, repair, and inspection. Therefore, the move to ISO 27415 is not a simple matter for industry since it will impose significant development, hardware and software costs if required.

Consequently, GRPE endorsed the recommendation of the WWH-OBD group to move towards the application of a common standard in a step-wise approach within this gtr.

In a first application of this gtr, Contracting Parties would accept the use of any of either ISO 15765-4 or SAE J1939-73 (but recognising that these standards must be adapted to fully meet the requirements of this gtr) or ISO 27415.

In a future step, possibly aligned with step 3 mentioned in section 6.3 below, it may be appropriate for Contracting Parties to apply the use of just ISO 27415. However, in consideration of regional legislation that would require the use of just ISO 27415, Contracting Parties are encouraged to consider the timing of such legislation with respect to adequate industry leadtime, and the benefit to automotive industry sectors operating under the umbrella of "the automotive industry."

6.3 Harmonisation of the emission OBD threshold limits (OTLs)s

Harmonized OBD performance requirements will evolve with the harmonization of the test-cycles (for exhaust emissions and for emission related OBD), the emission limits and the process for calculating the OTLs.

The following table summarizes the recommended major steps towards fully harmonized OBD performance requirements::

	Step 1	Step 2	Step 3
Test-cycles (emissions and OBD)	Non-harmonized or harmonized	Harmonized	Harmonized
Emission limits	Non harmonized	Non harmonized	Harmonized
OTLs calculation process[11]	Non harmonized	Harmonized	Harmonized
OTLs	Regionally defined	Regionally calculated with the harmonized OTLs calculation process[11]	Harmonized

Table A.2 – steps towards OB harmonisation

Step 1:

In the first step, OTLs are not world-harmonized and the process for defining the OTLs is not world-harmonized;
The Contracting Parties decide the OTLs and whether or not they want to couple the introduction of this gtr in their own legislation with that of the "WHDC" gtr. In that case the test-cycles used in this gtr are world-harmonized; in the other case they are not.

The requirements of this first step are prescribed in module B of this gtr.

Step 2

In the second step, the test-cycles (for emissions and OBD) and the calculation process for defining the OTLs are world harmonized, but the emission limits are not world-harmonized;

[11] The harmonized OTL calculation process will be defined and agreed by WP29/AC3 in advance of any Contracting Party applying step2 of this gtr.

In that case, the OTLs are defined by applying the world-harmonised calculation process to the applicable regional emission limits.

Step 3

In this case, the test-cycles (for emissions and OBD), the emission limits and the calculation process to define the OTLs are harmonized.

This leads to world-harmonised OTLs that may be defined in a specific table within the gtr.

PART B:

TEXT OF REGULATION

1. PURPOSE

This gtr prescribes the requirements for on-board diagnostic (OBD) systems to detect, and, if applicable, record and/or communicate failures of specific vehicle and engine systems that affect the environmental or safety 12/ performance of these systems, as described in the specific modules of this gtr.

In addition, this gtr specifies the elements concerning the OBD system to facilitate the diagnosis and maintenance of specific vehicle and engine systems and the possible enforcement of road-worthiness measures without containing mandatory prescriptions for this purpose.

2. SCOPE

This gtr applies to vehicles of categories 1-2 and 2 [13], having a design speed exceeding 25 km/h and having a maximum mass exceeding 3.5 tonnes with regard to OBD systems.

It contains a modular structure, where
- module A is a "generic" module containing specifications applicable to all OBD systems
- - other modules are "specific" modules containing additional requirements that are limited to the specific system to which that module refers.

3. TRANSPOSITION [paragraph to be agreed]

Contracting Parties are not required to submit the technical regulation contained in this gtr to their adoption process earlier than three years after its establishment.
After the 3-year period, Contracting Parties may further postpone the submission if the postponement is needed to bring into force this gtr together with the gtrs on the World Heavy-Duty Test Cycle (WHDC) and / or on Off-Cycle Emissions (OCE).

12/ The current gtr only establishes requirements for emission-related OBD systems. Requirements addressing safety-related OBD systems may be added at a later date in accordance with future decisions of WP.29.

13/ See UN/ECE Special Resolution 1: "SPECIAL RESOLUTION CONCERNING COMMON DEFINITIONS AND PROCEDURES TO BE USED IN GLOBAL TECHNICAL REGULATIONS (S.R. 1)

MODULE A:

GENERIC OBD PROVISIONS

1. PURPOSE

This module prescribes the general requirements for on-board diagnostic (OBD) systems to detect, and, if applicable, record and/or communicate failures of specific vehicle and engine systems whether they affect the environmental or safety [12]/ performance of these systems, as described in the specific modules of this gtr.

In addition, this module specifies generic elements concerning the OBD system to facilitate the diagnosis and maintenance of specific vehicle and engine systems and the possible enforcement of road-worthiness measures without containing mandatory prescriptions for this purpose.

2. SCOPE

This module applies to OBD systems for vehicles of categories 1-2 and 2[13], having a design speed exceeding 25 km/h and having a maximum mass exceeding 3.5 tonnes.

3. DEFINITIONS

"Alert system"	means a system on-board the vehicle which informs the driver of the vehicle or any other interested party that the OBD system has detected a malfunction.
"Authority"	See "Certification authority" and "Contracting Party"
"Certification authority"	means the authority that grants the compliance certification of an OBD system considered by this gtr. Per extension it means also the technical service that has been accredited to evaluate the technical compliance of the OBD system.
"Component monitoring"	means the monitoring of input components for electrical circuit failures and rationality failures and monitoring of output components for electrical circuit failures and functionality failures.
"Contracting Party"	means the party signatory to the UNECE 1998 Agreement.
"Electrical circuit failure"	means a malfunction (e.g. open circuit or short circuit) that leads to the measured signal (i.e. voltages, currents, frequencies, etc.) being outside the range where the transfer function of the sensor is designed to operate.

"Functionality failure"	means a malfunction where an output component does not respond to a computer command in the expected way.
"Heavy-duty vehicle"	means a power driven vehicle of Category 1-2 or 2, as defined in Special Resolution No.1 (S.R.1), which has a design speed exceeding 25 km/h and a maximum mass exceeding 3,500 kg.
"Malfunction indicator (MI)"	is an indicator which clearly informs the driver of the vehicle in the event of a malfunction. The MI is part of the alert system.
"Malfunction"	means a failure or deterioration of a vehicle or engine system or component, including the OBD system, as defined in the specific modules of this gtr.
"National / Regional legislation"	means the legislation into which a Contracting Party will, if appropriate, introduce or apply the content of this gtr after having decided, at its discretion, on the options within the gtr.
"On-board diagnostic system (OBD)"	means a system on-board a vehicle or engine which has the capability of detecting malfunctions, and, if applicable, of indicating their occurrence by means of an alert system, of identifying the likely area of the malfunctions by means of information stored in computer memory, and/or communicating that information off-board.
"Qualified deteriorated component or system (QDC)"	means a component or system that has been intentionally deteriorated (e.g. accelerated aging) and/or manipulated in a controlled manner and which has been accepted by the authorities according to the provisions set in the applicable specific module as a qualified component for the purpose of demonstrating compliance of the OBD system with this gtr. 14/
"Rationality failure"	means a malfunction where the signal from an individual sensor or component is at variance with that expected when assessed against signals available from other sensors or components within the control system. Rationality failures include malfunctions that lead to the measured signal (i.e. voltages, currents, frequencies, etc.) being inside the range where the transfer function of the sensor is designed to operate.
Specific module	Means any module within part B of this GTR, with the exception of module A

14/ Specific modules may not require the use of such components or systems in their demonstration process.

4. GENERAL REQUIREMENTS

4.1. Monitoring requirements

The monitoring requirements are prescribed in the specific modules of this gtr.

4.2. Requirements for malfunction classification

Requirements for classifying malfunctions according to their possible effects are prescribed in the specific modules of this gtr.
Conformity of the classification shall be assessed at the time of certification of the OBD system.

4.3. Alert system

Requirements applicable to alert systems are specific to each OBD system and are prescribed in the specific modules of this gtr

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

4.3.1. Malfunction indicator (MI)

Requirements applicable to the Malfunction indicator (MI), including its activation / deactivation schemes, are specific to each OBD system and are prescribed in the specific modules of this gtr

The malfunction indicator shall be perceptible by the driver from the driver's seat position.

4.4. OBD Diagnostic information

Requirements applicable to OBD information (e.g. alert system status, OBD readiness, malfunction indication, diagnostic trouble codes, etc…) are specific to each OBD system and are prescribed in the specific modules of this gtr

Nevertheless, communication and access to OBD information shall, at a minimum, fulfil the requirements of the following sub-paragraphs.

4.4.1. Access to OBD diagnostic information

Access to OBD information shall be provided only in accordance with the standards mentioned in Annex 1 of this module and the following sub-paragraphs[15].

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

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

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

Access to OBD information shall be provided using, at least one of the following series of standards mentioned in Annex1:
- ISO 15765-4
- SAE J1939-73
- ISO 27145

A Contracting Party may decide if and when to require only the use of ISO 27145[16].

4.4.1.1. CAN based wired communication

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

It is the manufacturer's responsibility to select the baud-rate and to design the OBD system according to the requirements specified in the standards mentioned in Annex 1, and referred to in the specific modules. The OBD system shall be tolerant against the automatic detection between these two baud-rates exercised by the external test equipment.

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

4.4.1.2 TCP/IP (Ethernet) based wired communication

The interface between the vehicle and the external diagnostic test equipment (e.g. scan-tool) shall comply with the requirements of ISO standard 27145 – part 4 (see Annex 1)

4.4.1.3 Connector location

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[16] see also paragraph 6.2 in part A

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

Contracting Parties may allow the certification authority to approve upon request of the manufacturer an alternative location provided the installation position shall be easily accessible and protected from accidental damage during normal conditions of use.

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

The manufacturer may equip vehicles with additional diagnostic connectors and data-links for manufacturer-specific purposes other than the required OBD functions. If the additional connector conforms to one of the standard diagnostic connectors allowed in Annex 1, only the connector required by this gtr shall be clearly labelled "OBD" to distinguish it from other similar connectors.

4.4.2 Erasing OBD information

The OBD system shall clear recorded OBD information in accordance with the provisions of the specific modules, when this request is provided via the external repair test equipment according to the standards of Annex 1 to this module.

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

4.5. Durability of the OBD system

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

Any additional provisions addressing the durability of OBD systems are contained in the specific modules.

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

5. PERFORMANCE REQUIREMENTS

Detailed provisions concerning performance requirements of an OBD system are contained in the specific modules.

Temporary disablement strategies of the OBD system are defined in the specific modules and shall apply only to the specific module.

6. DEMONSTRATION REQUIREMENTS

Detailed provisions concerning the demonstration of an OBD system's conformity with the requirements of the applicable modules of this gtr are contained in the specific modules.

7. TEST PROCEDURES

The detailed provisions concerning the applicable test procedure(s) for demonstrating compliance of an OBD system are contained in the specific modules.

8. DOCUMENTATION REQUIREMENTS

Unless otherwise specified in the specific modules the following documentation requirements will, at a minimum, apply:

The manufacturer shall provide a documentation package to the authority that completely describes the functional characteristics of the OBD system as required in detail in the specific modules.

This package shall be separated into two parts:

- a first part containing non confidential information.

- a second part containing the pieces of information that will be treated as strictly confidential.

The content of each part is defined in the specific modules.

8.2 Treatment of OBD confidential documentation

The content of the second part of the documentation package shall be treated as strictly confidential. It may nevertheless be shared with other certification authorities according to the laws and regulations of each Contracting Party.

9. ANNEXES

Annex 1: Reference standard documents

Annex 1 contains the references to the industry standards that are to be used in accordance to the provisions of this gtr to provide the serial communications interface to the vehicle/engine. There are three allowed solutions identified, ISO 15765-4 or SAE J1939-73 or ISO 27145. In addition there are other ISO or SAE standards that are applicable in accordance with the provisions of this gtr.

Annex 1

REFERENCE STANDARD DOCUMENTS

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

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

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

(i) ISO 27145 dated dd.mm.yy Road vehicles - On board diagnostics (WWH-OBD) implementation – Part 1 - General Information and use case definitions

(ii) ISO 27145 dated dd.mm.yy Road vehicles - On board diagnostics (WWH-OBD) implementation - Part 2 - Common emissions-related data dictionary

(iii) ISO 27145 dated dd.mm.yy Road vehicles - On board diagnostics (WWH-OBD) implementation - Part 3 - Common message dictionary

(iv) ISO 27145 dated dd.mm.yy Road vehicles - On board diagnostics (WWH-OBD) implementation - Part 4 - Connection between vehicle and test equipment

(v) ISO 27145 dated dd.mm.yy Road vehicles - On board diagnostics (WWH-OBD) implementation - Part 5 - Conformance test

(vi) ISO 27145 dated dd.mm.yy Road vehicles - On board diagnostics (WWH-OBD) implementation - Part 6 - External test equipment

The following International Organization of Standards (ISO) documents are incorporated by reference into this regulation:
ISO 15031-3 “Road vehicles — Communication between vehicle and external test equipment for emissions-related diagnostics — Part 3: Diagnostic connector and related electrical circuits, specification and use,” July 2003

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

SAE J2403 "Medium/Heavy-Duty E/E Systems Diagnosis Nomenclature," August 2004.

SAE J1939-13 “Off-Board Diagnostic Connector,” dated March 2004.

MODULE B

EMISSION–RELATED OBD FOR HEAVY-DUTY DIESEL ENGINE SYSTEMS

1. PURPOSE

This module complements the generic provisions specified in Module A by prescribing additional specific requirements for OBD systems to detect record and communicate emission-related malfunctions from heavy-duty diesel engine systems that would affect the environmental performance of those systems.

This module specifies the elements concerning the emission-related OBD system to facilitate the diagnosis and maintenance of the engine system and the possible enforcement of road-worthiness measures.

[paragraph to be agreed]

To serve this the purpose of this module, Contracting Parties are authorised to establish complementary requirements and to adapt requirements to technical progress in accordance with Article 7.6 of the 1998 Agreement.

2. SCOPE

This module applies to the emission related OBD system for diesel fuelled engines equipped on vehicles of categories 1-2 and 2[13], having a design speed exceeding 25 km/h and having a maximum mass exceeding 3.5 tonnes.
This module applies also to the installation of that OBD system, when a Contracting Party requires certification of that installation.

3. DEFINITIONS

"Calibration verification number"	means the number that is calculated and reported by the engine system to validate the calibration / software integrity
"Component monitoring"	refers in the context of this module to components that are electrically connected to the controller(s) of the engine system. *(Definition of Module A further qualified 17/)*
"Confirmed and active DTC"	means a DTC that is stored during the time the OBD system concludes that a malfunction exists

17/ The generic definitions in paragraph 3. of Module A of this gtr shall apply for the purpose of this module. Nevertheless further qualification is given to be consistent with the scope of the present specific module.

"Continuous-MI"	means the malfunction indicator showing a steady indication at all times while the key is in the on (run) position with the engine running (ignition on – engine on).
"Deficiency"	means an OBD monitoring strategy or other OBD feature that does not meet all the detailed requirements of module A or of this module.
"Diagnostic trouble code (DTC)"	means a numeric or alphanumeric identifier which identifies or labels a malfunction.
"Emission OBD family"	means a manufacturer's grouping of engine systems having common methods of monitoring / diagnosing emission-related malfunctions.
"Emission threshold monitoring"	means monitoting of a malfunction that leads to an exceedance of the OTLs. It consists of: (a) Direct emissions measurement via a tailpipe emissions sensor(s) and a model to correlate the direct emissions to test-cycle specific emissions; and/or (b) Indication of an emissions increase via correlation of computer input/output information to test-cycle specific emissions.
"Engine system"	means the engine as it would be configured when tested for its exhaust emissions on a certification test-bed, including: (a) the engine's electronic management controller(s) (b) the exhaust after-treatment system(s) (c) any emission-related component of the engine or the exhaust system which supplies input to, or receives output from, the engine's electronic management controller(s); and (d) the communication interface (hardware and messages) between the engine's electronic management controller(s) and any other powertrain or vehicle control unit if the exchanged information has an influence on the control of emissions.

"Malfunction emission control strategy (MECS)"	means a strategy within the engine system that is activated as a result of an emission-related malfunction.
"Malfunction indicator"	see also "Continuous-MI", "On-demand-MI", and "Short-MI"
"Malfunction"	refers in the context of this module to a failure or deterioration of an engine system, including the OBD system, that may lead either to an increase in any of the regulated pollutants emitted by the engine system or to a reduction in the effectiveness of the OBD system. *(Definition of Module A further qualified 14/)*
"MI status"	means the command status of the MI, being either continuous-MI, Short-MI, on-demand-MI, or off.
"Monitoring"	see also "Emission threshold monitoring", "Performance monitoring", and "Total functional failure monitoring".
"OBD test-cycle"	means the cycle over which an engine system is operated on an engine test-bed to evaluate the response of an OBD system to the presence of a qualified deteriorated component.
"OBD"	refers in the context of this module to an on-board diagnostic system dedicated to malfunctions affecting the emission performance of the engine system. *(Definition of Module A further qualified 14/)*
"OBD-parent engine system"	means an engine system that has been selected from an emission-OBD family for which most of its OBD elements of design are representative of that family.
"On-demand-MI"	means the malfunction indicator showing a steady indication in response to a manual demand from the driving position when the key is in the on (run) position with the engine off (ignition on – engine off).

"Operating sequence"	means a sequence consisting of an engine start-up, an operating period, an engine shut-off, and the time until the next start-up, where a specific OBD monitor runs to completion and a malfunction would be detected if present.
"Pending DTC"	means a DTC that is stored by the OBD system because a monitor has detected a situation where a malfunction may be present during the current or last completed operating sequence.
"Performance monitoring"	means malfunction monitoring that consists of functionality checks and monitoring parameters that are not correlated to emission thresholds. Such monitoring is typically done on components or systems to verify that they are operating within the proper range (e.g. differential pressure in case of a DPF).
"Potential DTC"	means a DTC that is stored by the OBD system because a monitor has detected a situation where a malfunction may be present but requires further evaluation to be confirmed. A potential DTC is a pending DTC which is not a confirmed and active DTC.
"Previously active DTC"	means a formerly confirmed and active DTC that remains stored after the OBD system has concluded that the malfunction that caused the DTC is no longer present.
"Readiness"	means a status indicating whether a monitor or a group of monitors have run since the last erasing by request of an external OBD scan-tool.
"Scan-tool"	means an external test equipment used for standardised off-board communication with the OBD system in accordance with the requirements of this module.
"Short-MI"	means the malfunction indicator showing a steady indication from the time the key is moved to on (run) position and the engine is started (ignition on – engine on) and extinguishing after 15 seconds or the key is moved to off, whichever occurs first.

"Software calibration identification"	means a series of alphanumeric characters that identifies the emission-related calibration / software version(s) installed in the engine system.
"Total functional failure monitoring"	means monitoring a malfunction which is leading to a complete loss of the desired function of a system.
"Warm-up cycle"	means sufficient engine operation such that the coolant temperature has risen by at least 22K (22°C / 40°F) from engine starting and reaches a minimum temperature of 333K (60°C / 140°F)18/

3.1. Abbreviations

CV Crankcase Ventilation
DOC Diesel Oxidation Catalyst
DPF Diesel Particulate Filter or Particulate Trap including catalyzed DPFs and Continuously Regenerating Traps (CRT)
DTC Diagnostic trouble code
EGR Exhaust Gas Recirculation
HC Hydrocarbon
LNT Lean NOx Trap (or NOx adsorber)
MECS Malfunction Emission Control Strategy
NOx Oxides of Nitrogen
OTL OBD Threshold Limit
PM Particulate Matter
SCR Selective Catalytic Reduction
SW Screen Wipers
TFF Total Functional Failure monitoring
VGT Variable Geometry Turbocharger
VVT Variable Valve Timing

4. GENERAL REQUIREMENTS

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

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

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

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

4.1. Application for certification of an OBD system

4.1.1. Primary certification

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

- The manufacturer of an engine system applies for the certification of an individual OBD system by demonstrating that OBD system complies with all the provisions of modules A and B of the present gtr.

- The manufacturer of an engine system applies for the certification of an emission-OBD family by demonstrating that the OBD-parent engine system of the family complies with all the provisions of modules A and B of the present gtr.

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

4.1.2. Extension / Modification of an existing certificate

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

At the request of the manufacturer and upon approval of the certification authority, a new engine system may be included as a member of a certified emission-OBD family if all the engine systems within the so-extended emission-OBD family still have common methods of monitoring / diagnosing emission-related malfunctions.

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

If the new engine system contains elements of design that are not represented by the OBD-parent engine system but itself would represent the whole family, then the new engine system shall become the new OBD-parent engine system. In this case the new

OBD elements of design shall be demonstrated to comply with the provisions of Modules A and B of this gtr, and the documentation package shall be modified according to paragraph 8. of this module.

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

At the request of the manufacturer and upon approval of the certification authority, an extension of an existing certificate may be granted in the case of a design change of the OBD system if the manufacturer demonstrates that the design changes comply with the provisions of Modules A and B of this gtr.

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

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

4.1.2.3. Certificate modification to address a malfunction reclassification

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

The compliance of the new classification shall then be demonstrated according to the provisions of modules A and B of this gtr and the documentation package shall be modified according to paragraph 8 of this module.

4.2. Monitoring requirements

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

The OBD system shall also monitor its own components.

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

The appendices also identify enhanced monitoring requirements that may be introduced, some or all, into a national / regional regulation, where determined to be technically feasible and appropriate (i.e. environmentally cost-effective) by a Contracting Party at the time of introduction of that regulation.

Contracting Parties may prescribe monitoring requirements for systems and / or components that are not mentioned in annex 3; They will take Annex 3 as a basis for setting this additional requirements

The manufacturer can also decide to monitor additional systems and components.

4.2.1. Selection of the monitoring technique

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

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

4.2.1.1. Correlation to actual emissions

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

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

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

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

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

the monitors are still needed for the purpose of malfunction isolation.

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

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

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

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

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

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

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

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

4.2.2.1. Exception to component monitoring

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

- the failure results in an emission increase of any pollutant of less than 50 per cent of the regulated emission limit, and
- the failure does not cause any emission to exceed the regulated emission limit 19/, and
- the failure does not affect a component or system enabling the proper performance of the OBD system.

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

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

4.2.3. Monitoring frequency

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

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

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

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

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

4.3. Requirements for recording OBD information

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

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

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

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

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

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

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

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

4.4. Requirements for erasing OBD information

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

4.5. Requirements for malfunction classification

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

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

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

If an MECS is activated as a result of the detection of a malfunction, this malfunction shall be classified based on either the emission impact of the activated MECS or its

impact on other monitoring capability. The malfunction shall then assigned to the class that takes precedence in the discriminatory display strategy.

4.5.1. Class A malfunction

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

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

4.5.2. Class B1 malfunction

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

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

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

4.5.3. Class B2 malfunction

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

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

4.5.4. Class C malfunction

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

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

4.6. Alert system

4.6.1. MI specification

The malfunction indicator shall be a visual signal that is perceptible under all lighting conditions. The malfunction indicator shall comprise a yellow (as defined in Annex 5 to

UN/ECE Regulation No. 7) or amber (as defined in Annex 5 to UN/ECE Regulation No. 6) warning signal identified by the F01 symbol in accordance with ISO Standard 2575:2004.

4.6.2. MI illumination schemes

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

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

A Contracting Party implementing this gtr may require a discriminatory or a non-discriminatory display strategy. These strategies are defined in paragraphs 4.6.3.1. and 4.6.3.2.

The discriminatory display strategy requires the MI to be activated according to the class in which a malfunction has been classified. The non-discriminatory display strategy requires only a single type of MI activation.

The alert system shall provide both strategies and the MI's default display strategy shall be the discriminatory display strategy. This default strategy shall be locked by software coding that shall not be routinely available via the scan tool.

In order to gain access to the market of a Contracting Party implementing this gtr, the manufacturer may be required to enable the non-discriminatory display strategy. In this instance, the market selection of the discriminatory or the non-discriminatory display strategy shall be possible from the scan tool.

At key on, engine off, a single MI activation strategy is required. This strategy is described in paragraph 4.6.4.

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

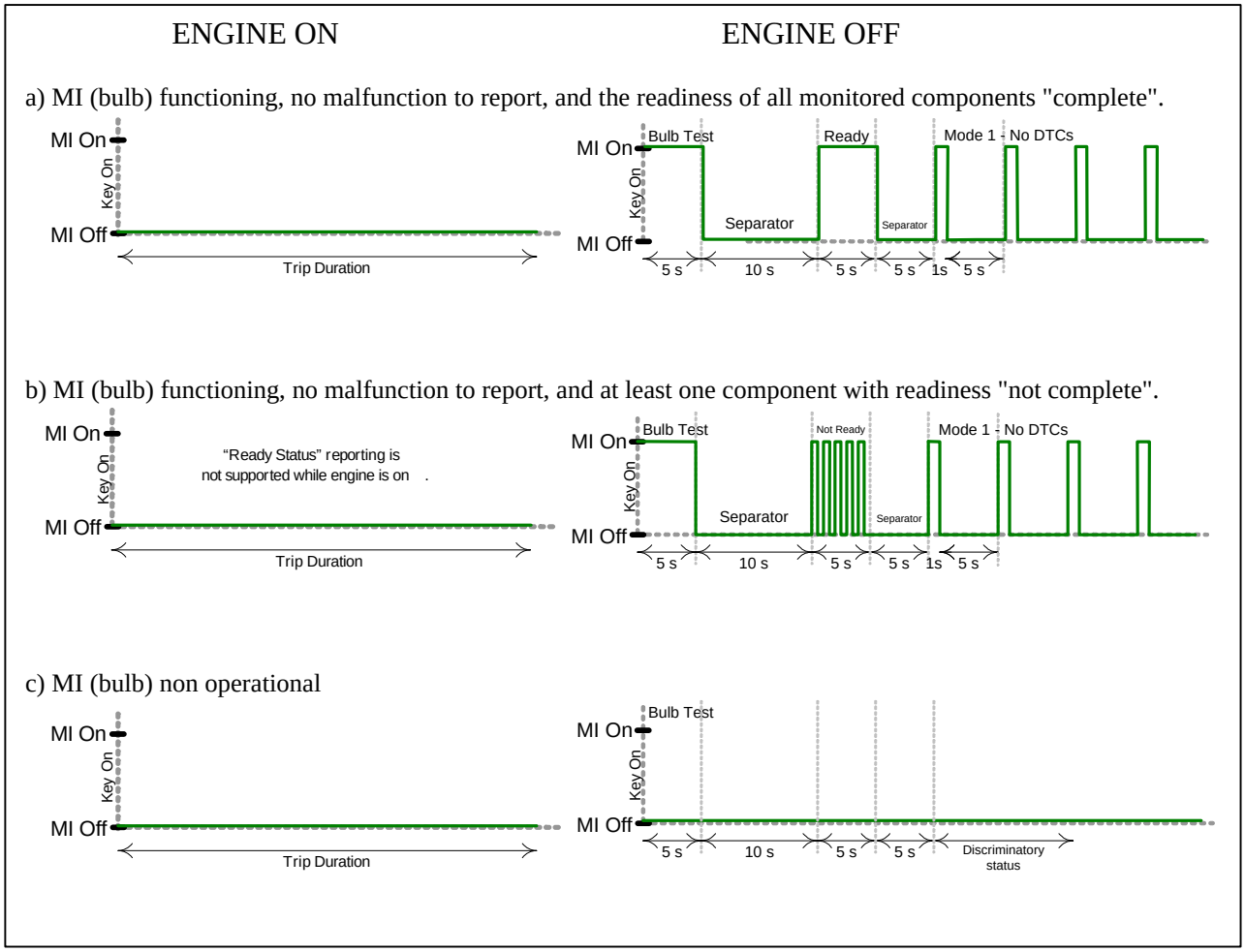

Figure B1

Bulb test and readiness indication

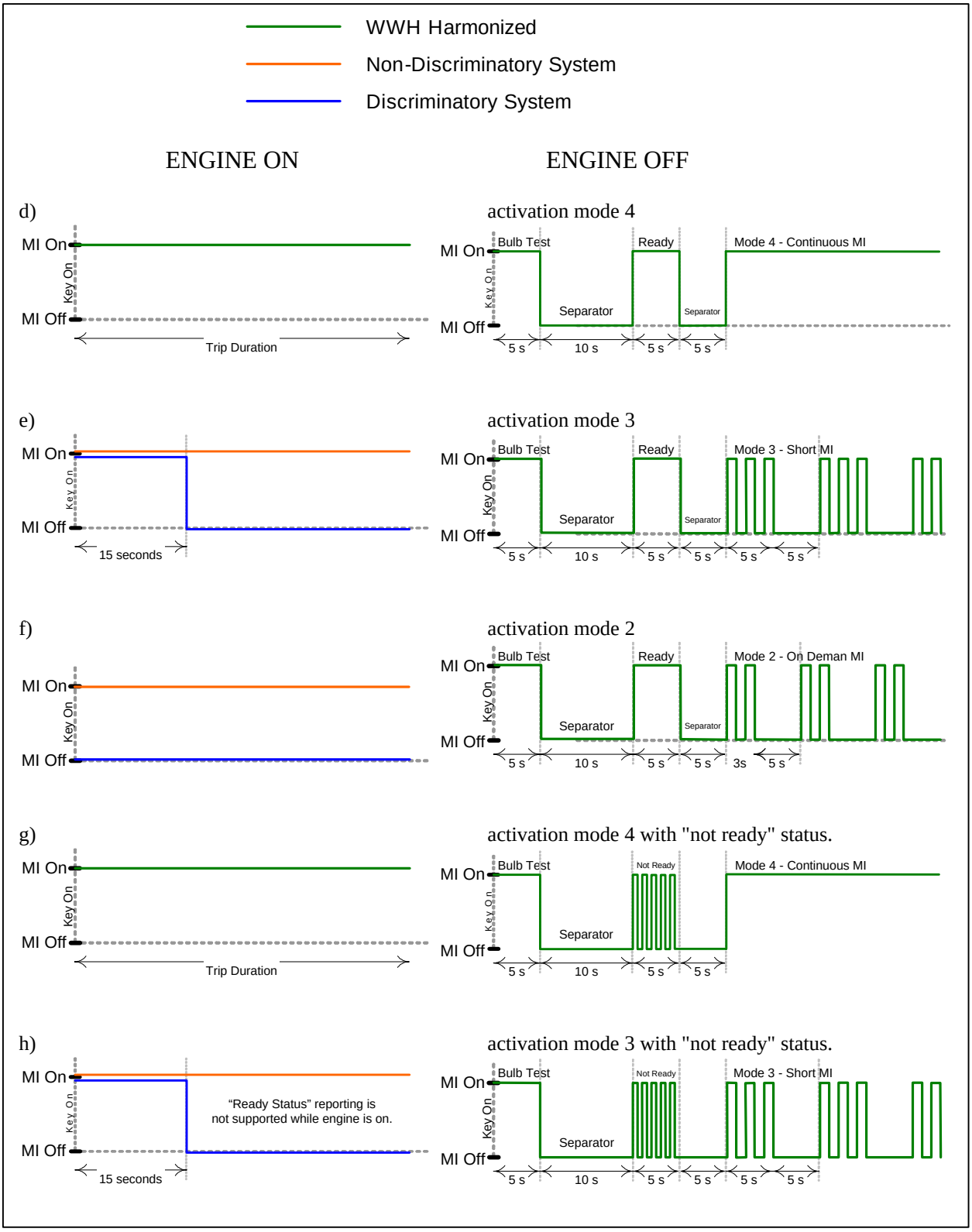

Figure B2:

Malfunction display strategy

4.6.3. MI activation at "engine on"

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

4.6.3.1. Discriminatory Display strategy

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

4.6.3.1.1. Class A Malfunctions

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

4.6.3.1.2. Class B Malfunctions

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

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

4.6.3.1.3. Class C malfunctions

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

4.6.3.1.4. MI de-activation scheme

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

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

4.6.3.2. Non-discriminatory display strategy

The OBD system shall command a continuous-MI upon storage of a confirmed and active DTC associated with a Class A, B or C malfunction.

4.6.3.2.1. MI de-activation scheme

The "continuous-MI" shall be deactivated if the malfunction is not detected during 3 subsequent sequential operating sequences and the MI is not activated due to any other malfunction.

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

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

- the first sequence is designed to provide an indication of the MI functionality and the readiness of the monitored components;
- the second sequence is designed to provide an indication of the presence of a malfunction.

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

4.6.4.1. MI functionality/readiness

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

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

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

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

The MI shall then remain off for 5 seconds.

4.6.4.2. Presence / absence of a malfunction

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

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

4.6.4.2.1. Activation mode 1 – Absence of malfunction

The MI shall blink for one flash.

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

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

4.6.4.2.3. Activation mode 3 – "short-MI"

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

4.6.4.2.4. Activation mode 4 – "continuous-MI"

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

4.6.6. Counters associated with malfunctions

4.6.6.1. MI Counters

4.6.6.1.1. Continuous-MI Counter

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

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

The Continuous-MI counter shall operate as follows:

- if starting from zero, the continuous-MI counter shall begin counting as soon as a continuous-MI is activated
- the continuous-MI counter shall halt and hold its present value when the continuous-MI is no longer activated.
- the continuous-MI counter shall continue counting from the point at which it had been held if a malfunction that results in a continuous-MI is detected within 3 operating sequences.
- the continuous-MI counter shall start again counting from zero when a malfunction that results in a continuous-MI is detected after 3 operating sequences since the counter was last held.
- the continuous-MI counter shall be reset to zero when:
- no malfunction that results in a continuous-MI is detected during 40 warm-up cycles or 200 engine operating hours since the counter was last held whichever occurs first; or

- the OBD scan tool commands the OBD System to clear OBD information.

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

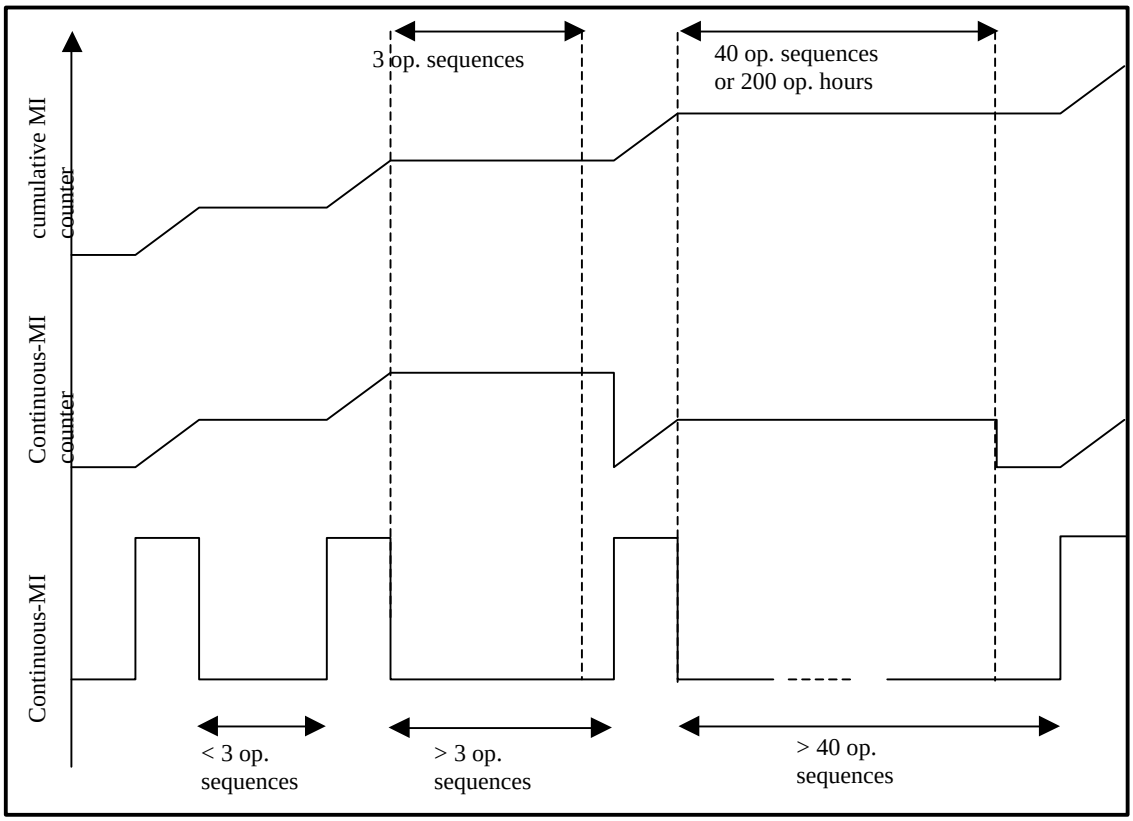

Figure C1:

Illustration of the MI counters activation principles

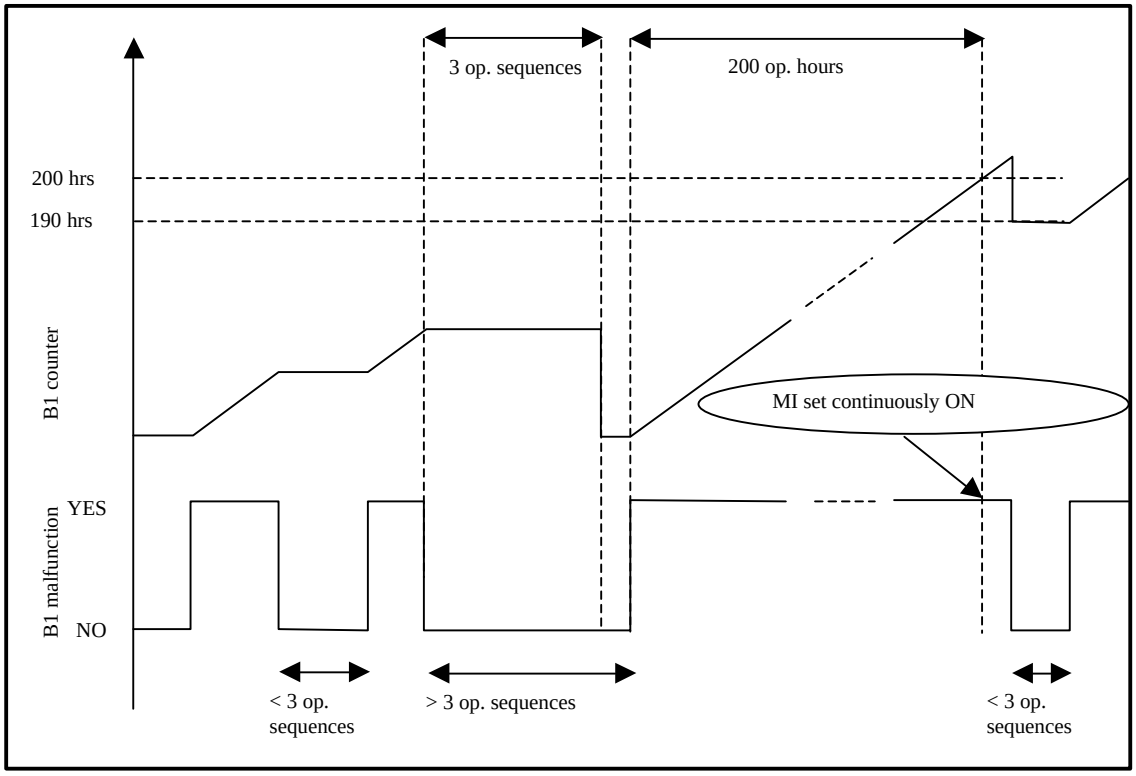

Figure C2:

Illustration of the B1 counter activation principles

4.6.6.1.2. Cumulative continuous-MI counter

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

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

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

The cumulative continuous-MI counter shall operate as follows:
- the cumulative continuous-MI counter shall begin counting when the continuous-MI is activated.
- the cumulative continuous-MI counter shall halt and hold its present value when the continuous-MI is no longer activated.
- the cumulative continuous-MI counter shall continue counting from the point it had been held when a continuous-MI is activated.

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

4.6.6.2. Counters associated with Class B1 malfunctions

4.6.6.2.1. Single B1-counter

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

The B1 counter shall operate as follows:
- the B1 counter shall begin counting as soon as a Class B1 malfunction is detected and a confirmed and active DTC has been stored.
- the B1 counter shall halt and hold its present value if no Class B1 malfunction is confirmed and active, or when all Class B1 malfunction have been erased by a scan tool.
- the B1 counter shall continue counting from the point it had been held if a subsequent Class B1 malfunction is detected within 3 operating sequences.

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

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

occurred during which no Class B1 malfunctions have been detected.

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

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

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

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

4.6.6.2.2. Multiple B1-counters

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

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

4.7. OBD Diagnostic information

4.7.1. Recorded information

The information recorded by the OBD system shall be available upon off-board request in the following packages manner:
- information about the engine state;
- information about emission-related malfunctions;
- information for diagnosis and repair.

4.7.1.1. Information about the engine state

This information will provide an enforcement agency 20/ with the malfunction indicator status and associated data (e.g. continuous-MI counter, readiness).

The OBD system shall provide all information (according to the applicable standard set in module A annex 1) for the external roadside check test equipment to assimilate the data and provide an enforcement agent with the following information:
- discriminatory/non-discriminatory display strategy
- the VIN (vehicle identification number)
- presence of a continuous-MI.
- the readiness of the OBD system

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

- the number of engine operating hours during which a continuous-MI was last activated (continuous-MI counter)

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

4.7.1.2. Information about active emission-related malfunctions

This information will provide any inspection station 21/ with a subset of engine related OBD data including the malfunction indicator status and associated data (MI counters), a list of active/confirmed malfunctions of classes A and B and associated data (e.g. B1-counter).

The OBD system shall provide all information (according to the applicable standard set in module A annex 1) for the external inspection test equipment to assimilate the data and provide an inspector with the following information:
- the gtr (and revision) number
- discriminatory/ non-discriminatory display strategy
- the VIN (vehicle identification number)
- the Malfunction Indicator status
- the Readiness of the OBD system
- number of warm-up cycles and number of engine operating hours since recorded OBD information was last cleared
- the number of engine operating hours during which a continuous-MI was last activated (continuous-MI counter)
- the cumulated operating hours with a continuous-MI (cumulative continuous-MI counter).
- the value of the B1 counter with the highest number of engine operating hours
- the confirmed and active DTCs for Class A malfunctions
- the confirmed and active DTCs for Classes B (B1 and B2) malfunctions
- the confirmed and active DTCs Class B1 malfunctions
- the software calibration identification(s)
- the calibration verification number(s).

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

4.7.1.3. Information for repair

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

The OBD system shall provide all information (according to the applicable standard set in module A annex 1) for the external repair test equipment to assimilate the data and provide a repair technician with the following information:
- the gtr (and revision) number

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

- the VIN (vehicle identification number)
- the malfunction indicator status
- the readiness of the OBD system
- number of warm-up cycles and number of engine operating hours since recorded OBD information was last cleared
- monitor status (i.e., disabled for the rest of this drive cycle complete this drive cycle, or not complete this drive cycle) since last engine shut-off for each monitor used for readiness status
- the number of engine operating hours since the malfunction indicator has been activated (countinuous MI counter)
- the confirmed and active DTCs for Class A malfunctions
- the confirmed and active DTCs for Classes B (B1 and B2) malfunctions
- the cumulated operating hours with a continuous-MI (cumulative continuous-MI counter).
- the value of the B1 counter with the highest number of engine operating hours
- the confirmed and active DTCs for Class B1 malfunctions and the number of engine operating hours from the B1-counter(s)
- the confirmed and active DTCs for Class C malfunctions
- the pending DTCs and their associated class
- the previously active DTCs and their associated class
- real-time information on OEM selected and supported sensor signals, internal and output signals (see paragraph 4.7.2 and Annex 5)
- the freeze frame data requested by this module (see paragraph 4.7.1.4 and Annex 5)
- the software calibration identification(s)
- the calibration verification number(s).

The OBD system shall clear all the recorded malfunctions of the engine system and related data (operating time information, freeze frame, etc…) in accordance with the provisions of this module, when this request is provided via the external repair test equipment according to the applicable standard set in module A annex 1.

4.7.1.4. Freeze frame information

If required by a Contracting Party, the OBD system may provide access to a subset of the following requirements:

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

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

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

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

4.7.1.5. Readiness

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

Normal engine shutdown shall not cause the readiness to change.

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

4.7.2 Data Stream Information

If required by a Contracting Party, the OBD system may provide access to a subset of the following requirements:

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

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

Table 1 in Annex 5 gives the list of mandatory OBD information relating to the engine load and speed.

Table 2 in Annex 5 shows the other OBD information which must be included if used by

the the emission or OBD system to enable or disable any OBD monitors22.

Table 3 in Annex 5 shows the information which is required to be included if the engine is so equipped, senses or calculates the information**22**. At the decision of the manufacturer, other freeze frame or data stream information may be included.

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

4.7.3. Access to OBD information

Access to OBD information shall be provided in accordance to the specifications of the standards referred to in module A annex 1.

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

OBD data shall be provided by the OBD system upon request using scan tool that complies with the requirements of the applicable standards mentioned in module A annex 1 (communication with external tester).

4.7.4 Erasing / resetting OBD information by a scan-tool

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

OBD information data	Erasable	Resetable[23]
malfunction indicator status		X
readiness of the OBD system		X
number of engine operating hours since the malfunction indicator has been activated (continuous MI counter)	X	
all DTCs	X	
the value of the B1 counter with the highest number of engine operating hours		X
the number of engine operating hours from the B1-counter(s)		X
the freeze frame data requested by this module	X	

4.8. Electronic security

If electronic security is required by a Contracting Party, the following requirements apply:

Any vehicle with an emission control unit must include features to deter modification,

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

23 (to the value specified in the appropriate section of this GTR)

except as authorized by the manufacturer. The manufacturer shall authorize modifications if these modifications are necessary for the diagnosis, servicing, inspection, retrofitting or repair of the vehicle.

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

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

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

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

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

5. PERFORMANCE REQUIREMENTS

5.1. Thresholds

The OTLs for the applicable monitoring criteria defined in Annex 3 are defined by the Contracting Party as follows:

- if the "WHDC" gtr is used for certifying the engine with regard to its exhaust emissions, the world harmonized OBD test cycle as defined in this module applies and the relevant regional OTLs shall be applicable accordingly.
- if the current UN-ECE Regulation is used for certifying the engine with regard to its exhaust emissions, the UN-ECE Regulation No. 49 OBD test-cycle and the UN-ECE Regulation OTLs shall be applicable accordingly.
- if the European Union regulation is used for certifying the engine with regard to its exhaust emissions, the EU OBD test-cycle and the EU OTLs shall be applicable accordingly..

- if the US or California regulation is used for certifying the engine with regard to its exhaust emissions, the US or California OBD test-cycle and the US or California OTLs shall be applicable accordingly.
- if the Japanese regulation is used for certifying the engine with regard to its exhaust emissions, the Japanese OBD test-cycle and the Japanese OTLs shall be applicable accordingly.

5.2. Temporary disablement of the OBD system

Contracting parties may allow certification authorities to approve that an OBD system be temporarily disabled under the conditions specified in the following sub-paragraphs.

If so, manufacturers shall obtain approval for temporary disablement strategies by the certification authority at the time of certification or type approval.

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

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

5.2.1. Engine/vehicle operational safety

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

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

5.2.2. Ambient temperature and altitude conditions 24/

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

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

24/ WWH-OCE conditions to be considered in the next revision of this gtr.

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

5.2.3. Low fuel level

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

5.2.4. Vehicle battery or system voltage levels

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

5.2.4.1. Low voltage

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

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

5.2.4.2. High voltage

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

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

5.2.5. Active PTO (power take-off units)

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

5.2.6. Forced regeneration

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

5.2.7. AECS

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

6. DEMONSTRATION REQUIREMENTS

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

- procedure for selecting the OBD-parent engine system. The OBD-parent engine system is selected by the manufacturer in agreement with the certification authority. It is subject to the complete demonstration process decided by the Contracting Party.
- procedure for demonstrating the classification of a malfunction. The manufacturer submits to the certification authority the classification of each malfunction for that OBD-parent engine system and the necessary supporting data in order to justify each classification. The manufacturer conducts the classification demonstration tests specified in this gtr as requested by the Contracting Parties.
- procedure for qualifying a deteriorated component. When the implementation rules of the Contracting Party require demonstrating by testing the qualification of the deteriorated component, the manufacturer provides, on request of the certification authority, deteriorated components for OBD testing purposes. These components are qualified on the basis of supporting data provided by the manufacturer. The certification authority may also, according to the implementation rules of the Contracting Party implementing this gtr, require emission testing to complete the qualification.

6.1. Emission-OBD family

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

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

6.1.1. Parameters defining an emission-OBD family

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

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

- the emission control systems,
- the methods of OBD monitoring,
- the criteria for performance and component monitoring
- the monitoring parameters (e.g. frequency)

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

The manufacturer may request approval by the certification authority of minor differences in the methods of monitoring/ diagnosing the engine emission control system due to engine system configuration variation, when these methods are considered similar by the manufacturer and:
- they differ only to match specificities of the considered components (e.g. size, exhaust flow, etc.); or
- their similarities are based on good engineering judgement.

6.1.2. OBD-parent engine system

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

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

Prior to testing the certification authority may decide to request the manufacturer to select an additional engine for demonstration.

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

6.2. Procedures for demonstrating the malfunction classification

The manufacturer shall provide the documentation justifying the proper classification of each malfunction to the certification authority. This documentation shall include a failure analysis (for example elements of a "failure mode and effect analysis") and may also include:
- simulation results;
- test results;
- reference to previously approved classification.

In the following paragraphs the requirements for demonstrating the correct classification are listed, including requirements for testing. The maximum and/or minimum number of tests to be required by the certification authority is defined by each Contracting Party.

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

6.2.1. Demonstration of classification into A

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

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

In that case the certification document shall record that the malfunction classification has been assigned according to the request of the certification authority.

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

In order to justify the classification of a malfunction into Class B1 the documentation shall clearly demonstrate that, in some circumstances[25], the malfunction results in emissions that are lower than the OTLs.

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

- the manufacturer selects the circumstances of the test in agreement with the certification authority
- the manufacturer shall not be required to demonstrate that in other circumstances the emissions due to the malfunction are actually above the OTLs.

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

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

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

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[25] E*xamples of circumstances that may influence if and when OTLs are exceeded are the age of the engine system or whether the test is conducted with a new or aged component.*

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

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

In case the certification authority disagrees with the classification of a malfunction as Class B2 because it considers that the OTLs are exceeded, the manufacturer may be required to demonstrate by testing that the emissions due to the malfunction are below the OTLs.

If the test fails, then the certification authority shall require the reclassification of that malfunction into A or B1 and the manufacturer shall subsequently demonstrate the appropriate classification and the documentation shall be updated.

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

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

6.2.6. Demonstration of classification into C

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

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

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

6.3. Procedures for demonstrating the OBD performance

The manufacturer shall submit to the certification authority a complete documentation package justifying the compliance of the OBD system as regards its monitoring capability, which may include:
- algorithms and decision charts
- tests and/or simulation results
- reference to previously approved monitoring systems, etc.

In the following paragraphs the requirements for demonstrating the OBD performance are listed, including requirements for testing. The maximum and/or minimum number of tests to be required by the certification authority is defined by each Contracting Party.

6.3.1. Procedures for demonstrating the OBD performance by testing

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

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

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

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

This paragraph applies to the cases where the malfunction selected for an OBD demonstration test is monitored against tailpipe emissions 26/ (emission threshold monitoring - see paragraph 4.2.), and the legislation of the Contracting Party requires the manufacturer to demonstrate, by an emission test, the qualification of that deteriorated component.

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

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

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

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

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

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

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

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

6.3.3. Test report

If a test report is required by a Contracting Party for certification purposes, that report shall contain, at a minimum, the information set out in Annex 4.

6.4. Certification of an OBD system containing deficiencies

6.4.1. Contracting parties may allow certification authorities to approve upon request of a manufacturer an OBD system even though the system contains one or more deficiencies.

In considering the request, the certification authority shall determine whether compliance with the requirements of this module is feasible or unreasonable.
The certification authority shall take into consideration data from the manufacturer that details such factors as, but not limited to, technical feasibility, lead time and production cycles including phase-in or phase-out of engines designs and programmed upgrades of computers, the extend to which the resultant OBD system will be effective in complying with the requirements of this gtr and that the manufacturer has demonstrated an acceptable level of effort toward meeting the requirements of the gtr.

The certification authority will not accept any deficiency request that includes the complete lack of a required diagnostic monitor (i.e. a complete lack of the monitors required in the appendices to annex 3).

A Contracting Party may prohibit a certification authority from approving a deficiency where that deficiency would result in the OTLs being exceeded.

6.4.2. Deficiency period

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

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

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

6.5. Direct certification of the installation of an OBD system on a heavy duty vehicle

If a Contracting Party requires or permits the direct certification of the installation of an OBD system on a vehicle, the requirements set in Annex 1 apply.

7. TEST PROCEDURES

7.1. Testing process

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

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

The engine system on which the OBD system is tested shall comply with the applicable emission requirements enforced by the Contracting Party.

7.1.1. Testing process for demonstrating the malfunction classification

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

According to paragraph 6.2.2., when testing is required by the certification authority to justify the classification of a malfunction into Class B1 rather than in Class A, the manufacturer shall demonstrate that the emissions due to that particular malfunction are, in selected circumstances, below the OTLs:

- the manufacturer selects these circumstances of test in agreement with the certification authority
- the manufacturer shall not be required to demonstrate that in other circumstances the emissions due to the malfunction are actually above the OTLs.

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

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

When testing is required by the certification authority to justify the classification of a malfunction into Class B2 rather than in Class B1 or into Class C rather than in Class B2, the emission test shall not be repeated. If the emissions measured in the test

are above the OTL or the emission limit, respectively, then the malfunction shall require a reclassification.

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

7.1.2. Testing process for demonstrating the OBD performance

When the certification authority requests according to paragraph 6.3. to test the OBD system performance, the compliance demonstration shall consist of the following phases (see chart 2):

- a malfunction is selected by the certification authority and a corresponding deteriorated component or system shall be made available by the manufacturer;
- when appropriate and if requested, the manufacturer shall demonstrate by an emission test that the deteriorated component is qualified for a monitoring demonstration;
- the manufacturer shall demonstrate that the OBD system responds in a manner that complies with the provisions of this gtr (i.e. MI indication, DTC storage, etc) at the latest by the end of a series of OBD test-cycles.

7.1.2.1. Qualification of the deteriorated component

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

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

In the case that the installation of a deteriorated component or device on an engine means that the full load curve (as determined with a correctly operating engine) cannot be attained during the test, the deteriorated component or device may be considered as qualified upon the agreement of the certification authority based on technical rationale provided by the manufacturer.

7.1.2.2. Malfunction detection

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

When it has been specified in the monitoring description and agreed by the certification authority that a specific monitor needs more than two operating sequences to complete

its monitoring, the number of OBD test-cycles may be increased according to the manufacturer's request.

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

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

7.2. Applicable tests

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

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

7.2.1. Emission test cycle

The World-wide harmonized test-cycle considered in this module for measuring emissions is the transient portion (WHTC test-cycle) of the World-wide harmonized heavy-duty certification procedure (WHDC).

When a Contracting Party decides to implement this gtr and the "WHDC" gtr is not implemented by this Contracting Party, the emission test-cycle required by that Contracting Party as mentioned in paragraph 6. and referred to in paragraph 7. will be the UN-ECE Regulation 49, European Union, Japanese, or United States test-cycle(s) applicable for emission measurement.

7.2.2. OBD test cycle

The World-wide harmonized OBD test-cycle considered in this module is the hot start part of the transient portion (WHTC test-cycle) of the World-wide harmonized heavy-duty certification procedure (WHDC).

When the engine-system has been certified to exhaust emissions limits measured over a test-cycle other than the WHDC, the OBD test-cycle may consist of the regionally accepted corresponding OBD test-cycles.

Manufacturers may request approval from the certification authority to use an alternative OBD test-cycle (for example the cold part of the test-cycle) to the applicable test-cycle mentioned in this paragraph. The request shall contain elements (technical considerations, simulation, test results, etc.) demonstrating:

- the requested test-cycle results in a monitor that will run in real world driving, and;
- the applicable world-wide harmonized or regionally accepted OBD test-cycle is

shown to be less appropriate for the considered monitoring (e.g. fluid consumption monitoring).

7.2.3. Test operating conditions

The conditions (i.e. temperature, altitude, fuel quality etc) for conducting the tests referred to in paragraphs 7.2.1. and 7.2.2. shall be those required for operating the World-wide harmonized heavy-duty certification procedure (WHDC) in the "WHDC" gtr.

If a Contracting Party decides to implement this gtr and the "WHDC" gtr is not implemented by this Contracting Party, the conditions for conducting the tests referred to in paragraphs 7.2.1. and 7.2.2. are the conditions required for operating the applicable regionally accepted emission test-cycle.

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

7.3. Test reports

If a test report is required by a Contracting Party for certification purposes, that report shall contain, at a minimum, the information set out in Annex 4.

8. DOCUMENTATION REQUIREMENTS

8.1. Documentation for purpose of certification

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

(a) a first part, which may be brief, provided that it exhibits evidence concerning the relationships between monitors, sensors/actuators, and operating conditions (i.e. describes all enable conditions for monitors to run and disable conditions that cause monitors not to run). The documentation shall describe the functional operation of the OBD, including the malfunction ranking within the hierarchical classification. This material shall be retained by the certification authority. This information may be made available to interested parties upon request.

(b) a second part containing any data, including details of qualified deteriorated components or systems and associated test results, which are used as evidence to support the decision process referred to above, and a listing of all input and output signals that are available to the engine system and monitored by the OBD system. This second part shall also outline each monitoring strategy and the decision process.

This second part shall remain strictly confidential. Upon decision of the contracting party implementing this gtr, it may be kept by the certification authority, or, at the discretion of the certification authority, may be retained by the manufacturer but shall be made open for inspection by the certification authority at the time of certification or at any time during the validity of the certification.

8.1.1. Documentation associated with each monitored component or system

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

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

8.1.2. Documentation associated with the malfunction classification

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

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

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

8.1.3. Documentation associated with the emission-OBD family

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

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

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

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

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

The engine manufacturer shall include in the installation documents of its engine system the appropriate requirements that will ensure the vehicle, when used on the road or elsewhere as appropriate, will comply with the requirements of this gtr. This documentation shall include but is not limited to:

- the detailed technical requirements, including the provisions ensuring the compatibility with the OBD system of the engine system;
- the verification procedure to be completed.

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

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

9. ANNEXES

Annex 1: Certification of installation of OBD systems
Annex 2: Malfunctions - Illustration of the DTC status – illustration of the MI and counters activation schemes
Annex 3: Monitoring Requirements
Annex 4: Technical compliance report
Annex 5: Freeze frame and data stream information

Annex 1

CERTIFICATION OF INSTALLATION OF OBD SYSTEMS

This annex considers the case where, according to section 6.5, the vehicle manufacturer requests certification of the installation on a vehicle of an OBD system / of OBD systems within an emission OBD family, that is / that are certified to the requirements of this GTR.

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

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

According to additional provisions set by a Contracting Party, the certification authority may also require an additional experimental verification in order to verify that the installation fully complies with the provisions of this gtr.
Correct MI illumination, information storage and on-board off-board OBD communication will be checked. But any check shall not force dismounting the engine system (e.g. an electric disconnection may be selected).

Annex 2

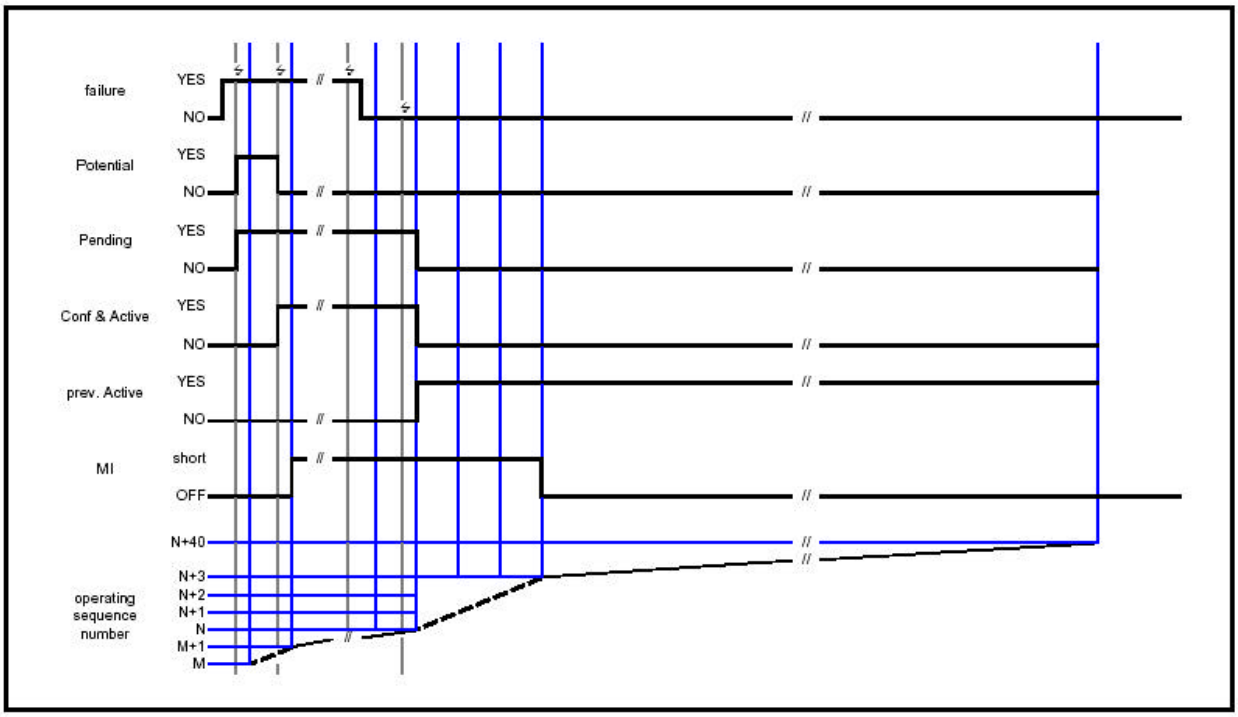
MALFUNCTIONS
ILLUSTRATION OF THE DTC STATUS
ILLUSTRATION OF THE MI AND COUNTERS ACTIVATION SCHEMES

This annex aims at illustrating the requirements set in paragraphs 4.3 and 4.6.6 of this module

It contains the following figures:

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

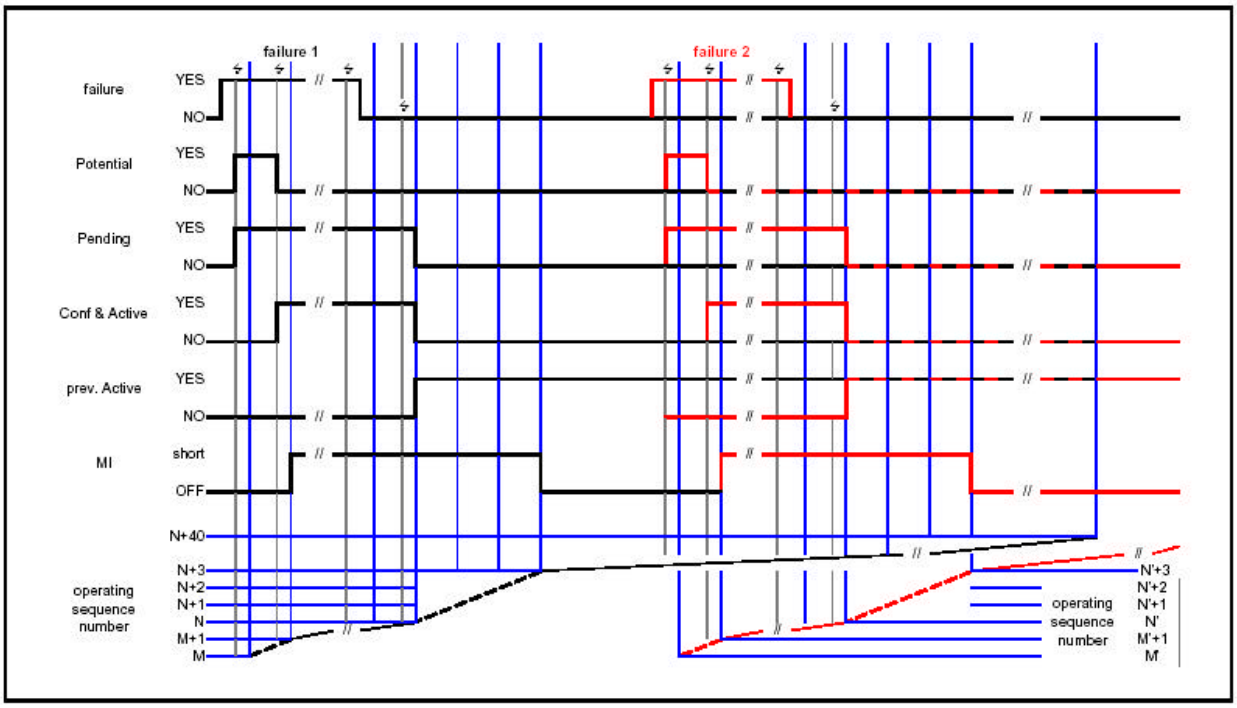
Figure 1: DTC status in case of a class B1 malfunction



Notes:

↯	means the point a monitoring of the concerned malfunction occurs
N, M	The gtr requires the identification of "key" operating sequences during which some events occurs, and the counting of the subsequent operating sequences. For the purpose of illustrating this requirement, the "key" operating sequences have been given the values N and M. For ex. M means the first operating sequence following the detection of a potential malfunction, and N means the operating sequence during which the MI is switched OFF.
N + 40	the 40th operating sequence after deactivation of the MI or 200 engine operating hours, whichever the earliest.

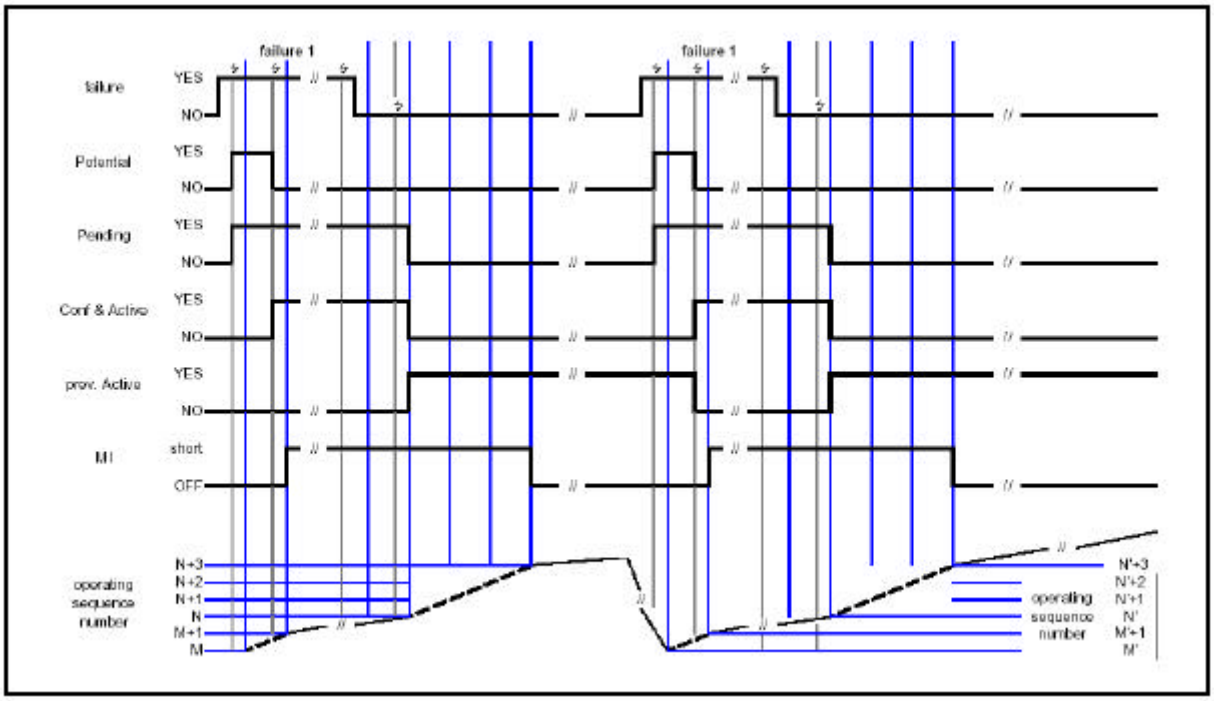
Figure 2 DTC status in case of 2 consecutive different class B1 malfunctions



Notes:

↯	means the point a monitoring of the concerned malfunction occurs
N, M, N', M'	The gtr requires the identification of "key" operating sequences during which some events occurs, and the counting of the subsequent operating sequences. For the purpose of illustrating this requirement, the "key" operating sequences have been given the values N and M for the first malfunction, respectively N' and M' for the second one. For ex. M means the first operating sequence following the detection of a potential malfunction, and N means the operating sequence during which the MI is switched OFF.
N + 40	the 40th operating sequence after the first deactivation of the MI or 200 engine operating hours, whichever the earliest.

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



Notes:

↯ means the point a monitoring of the concerned malfunction occurs

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

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

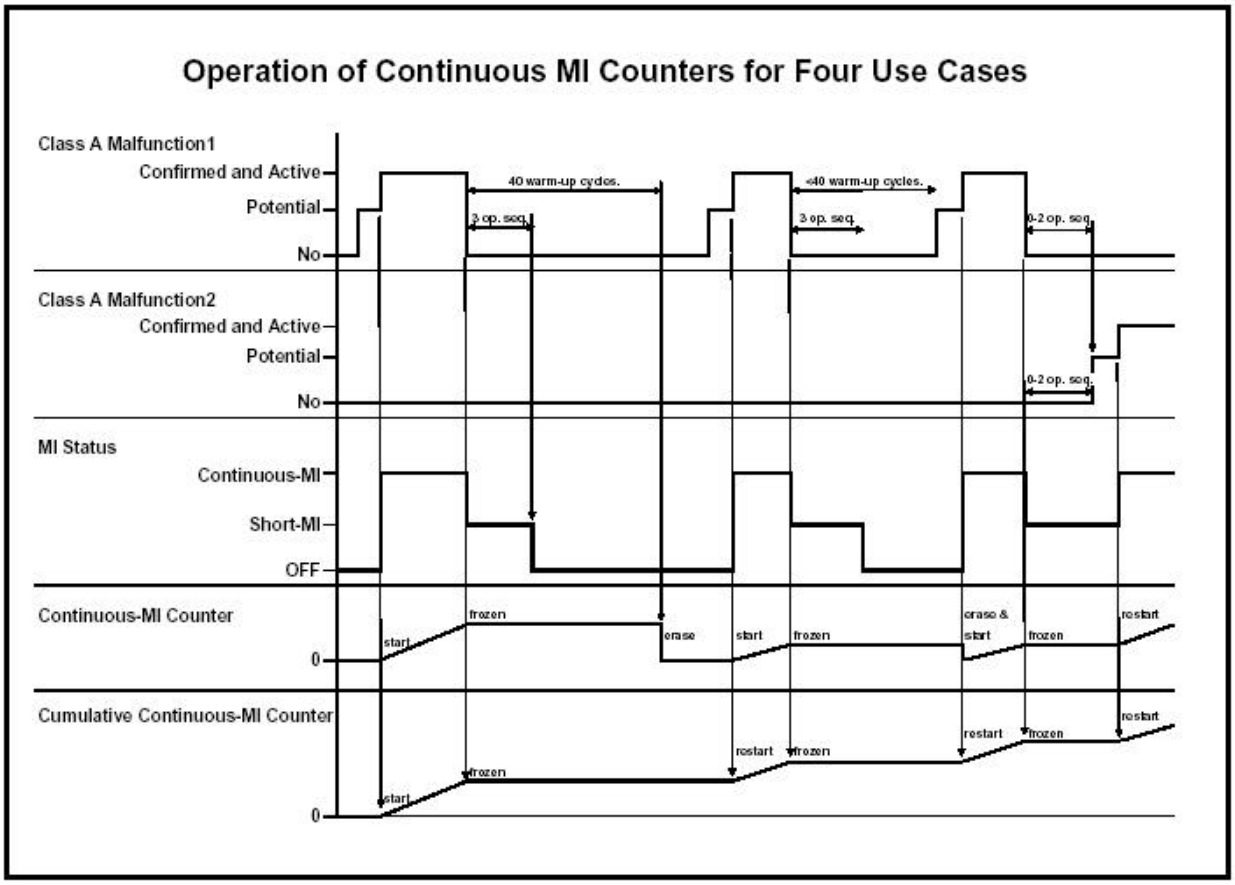
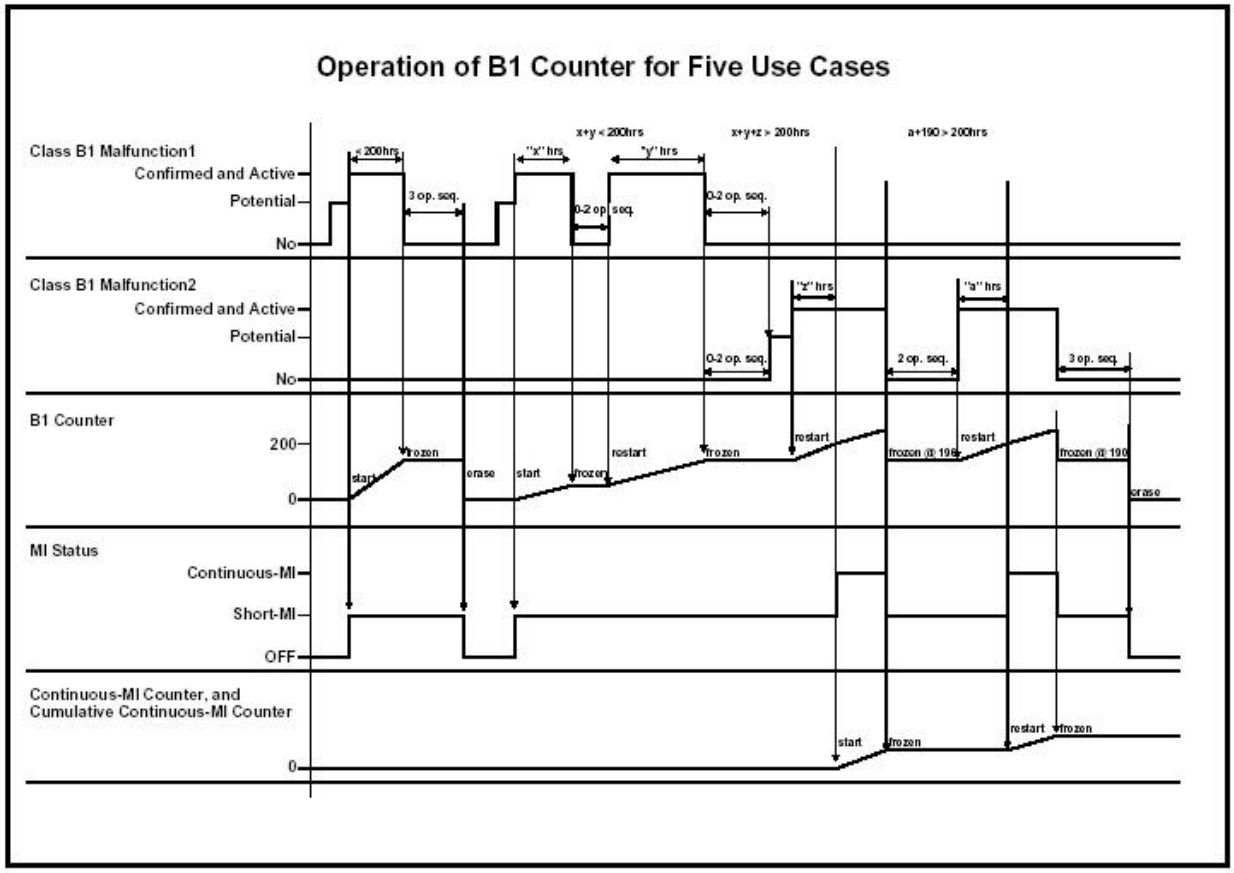


Figure 5: Class B1 malfunction – activation of the B1 counter in 5 use Cases.



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

Annex 3

MONITORING REQUIREMENTS

The appendices of this annex list the systems or components required to be monitored by the OBD system, according to section 4.2.

These appendices separate the basic monitoring requirements from the enhanced monitoring requirements that may be introduced, some or all, into a regional regulation by a Contracting Party at the time of introduction of that regulation, according to section 4.2.

Annex 3 - Appendix 1

ELECTRIC / ELECTRONIC COMPONENTS MONITORING

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

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

Annex 3 - Appendix 2

DIESEL PARTICULATE FILTER (DPF), OR PARTICULATE MATTER TRAP

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

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

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

- DPF filtering performance: the filtering capability of the DPF. This requirement would apply to PM emissions only – emission threshold monitoring.
- DPF forced regeneration excessive frequency: the frequency of forced regeneration events (i.e., those regeneration events that are initiated via a driver selectable switch or activator and/or those initiated by computer software). This requirement would apply to HC emissions – performance monitoring.
- DPF incomplete forced regeneration: forced regeneration events for completeness under manufacturer-defined conditions where regeneration is designed to occur – performance monitoring
- DPF HC conversion efficiency: the ability of the catalysed DPF to convert HC as required for compliance with emissions limits. – emission threshold monitoring.
- DPF active/intrusive reductant injection system: the system's ability to regulate reductant delivery properly, whether delivered via an in-exhaust injection or an in-cylinder injection – component monitoring.

Annex 3 - Appendix 3

SELECTIVE CATALYTIC REDUCTION (SCR) MONITORING

For the purpose of this appendix, SCR means selective catalytic reduction or other lean NOx catalyst device.

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

- active/intrusive reductant injection system: the system's ability to regulate reductant delivery properly, whether delivered via an in-exhaust injection or an in-cylinder injection – performance monitoring.
- active/intrusive reductant: the on-board availability of the reductant, the proper consumption of the reductant if a reductant other than fuel is used (e.g., urea) – performance monitoring.
- active/intrusive reductant: to the extent feasible the quality of the reductant if a reductant other than fuel is used (e.g., urea) – performance monitoring.

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

- SCR catalyst conversion efficiency: the catalyst's SCR ability to convert NOx - emission threshold monitoring.

Annex 3 - Appendix 4

LEAN-NOX TRAP (LNT, OR NOX ADSORBER)

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

- LNT capability: the LNT system's ability to adsorb/store and convert NOx – performance monitoring.
- LNT active/intrusive reductant injection system: the system's ability to regulate reductant delivery properly, whether delivered via an in-exhaust injection or an in-cylinder injection – performance monitoring.

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

- LNT capability: the LNT system's ability to adsorb/store and convert NOx – emission threshold monitoring.

Annex 3 - Appendix 5

DIESEL OXIDATION CATALYST (DOC) MONITORING

This appendix applies to DOC that are separate from other after-treatment systems. Those that are included in the canning of an after-treatment system are covered within the appropriate appendix of this annex.
The OBD system shall monitor the following elements of the DOC on engines so-equipped for proper operation:

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

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

- HC conversion efficiency: the DOC's ability to convert HC upstream of other after-treatment devices – emission threshold monitoring.
- Other aftertreatment assistance functions – catalysts upstream of other aftertreatment devices: the DOC's ability to generate an exotherm when used for that purpose (e.g., to assist in particulate filter regeneration); the DOC's ability to generate a necessary feedgas composition when used for that purpose (e.g., to increase NO2 concentration upstream of a urea selective catalytic reduction system (SCR)) – performance monitoring.
- Other aftertreatment assistance functions – DOCs downstream of other aftertreatment devices (e.g. aiming at HC conversion during DPF regeneration): the DOC's ability to convert HC - total functional failure monitoring.

Annex 3 - Appendix 6

EXHAUST GAS RECIRCULATION (EGR) SYSTEM MONITORING

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

- EGR low/high flow: the EGR system's ability to maintain the commanded EGR flow rate, detecting both "flow rate too low" and "flow rate too high" conditions – emission threshold monitoring.
- slow response of the EGR actuator: the EGR system's ability to achieve the commanded flow rate within a manufacturer specified time interval following the command – performance monitoring.
- EGR cooler undercooling performance: the EGR cooler system's ability to achieve the manufacturer's specified cooling performance – performance monitoring

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

- slow response of the EGR actuator: the EGR system's ability to achieve the commanded flow rate within a manufacturer specified time interval following the command – emission threshold monitoring.
- EGR cooler performance: the EGR cooler system's ability to achieve the manufacturer's specified cooling performance – emission threshold monitoring.

Appendix 7

FUEL SYSTEM MONITORING

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

- Fuel system pressure control: fuel system ability to achieve the commanded fuel pressure in closed loop control – performance monitoring.
- Fuel system pressure control: fuel system ability to achieve the commanded fuel pressure in closed loop control in the case where the system is so constructed that the pressure can be controlled independently of other parameters.– performance monitoring.
- Fuel injection timing: fuel system ability to achieve the commanded fuel timing for at least one of the injection events when the engine is equipped with the appropriate sensors - performance monitoring.

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

- Fuel system pressure control: fuel system ability to achieve the commanded fuel pressure in closed loop control in the case where the system is so constructed that the pressure can be controlled independently of other parameters - emission threshold monitoring
- Fuel injection quantity: fuel system ability to achieve the commanded fuel quantity by detecting errors from desired fuel quantity in at least one of the injection events when the engine is equipped with the appropriate sensors – emission threshold monitoring.
- Fuel injection timing: fuel system ability to achieve the commanded fuel timing for at least one of the injection events when the engine is equipped with the appropriate sensors - emission threshold monitoring

Appendix 8

AIR HANDLING AND TURBOCHARGER/BOOST PRESSURE CONTROL SYSTEM

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

- Turbo under/over boost: turbo boost system's ability to maintain the commanded boost pressure, detecting both "boost pressure too low" and "boost pressure too high" conditions – emission threshold monitoring.
- Variable geometry turbo (VGT) slow response: VGT system's ability to achieve the commanded geometry within a manufacturer specified time –performance monitoring.
- Charge air cooling: Charge air cooling system efficiency - total functional failure.

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

- Variable geometry turbo (VGT) slow response: VGT system's ability to achieve the commanded geometry within a manufacturer specified time – emission threshold monitoring.
- Charge air heating: Charge air heating ability to be used as part of a cold engine starting strategy against manufacturer specified limits - performance monitoring
- Charge air cooling: Charge air cooling system efficiency – emission threshold monitoring.

Appendix 9

VARIABLE VALVE TIMING (VVT) SYSTEM

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

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

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

- VVT target error: VVT system's ability to achieve the commanded valve timing – emission threshold monitoring.
- VVT slow response: VVT system's ability to achieve the commanded valve timing within a manufacturer specified time interval following the command – emission threshold monitoring

Appendix 10

MISFIRE MONITORING

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

For engines not equipped with combustion sensors:

- Continuous misfiring: misfire conditions occurring continuously in a cylinder. If more than one cylinder is misfiring continuously, then this must also be detected. The specific cylinder(s) that are misfiring need not be identified. – total functional failure.

For engines equipped with combustion sensors:

- Cylinder misfiring: misfire conditions in one cylinder or more – emission threshold monitoring.

Appendix 11

CRANKCASE VENTILATION SYSTEM MONITORING

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

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

- Crankcase Ventilation System (CV) integrity: CV system to ensure that no disconnections exist. Manufacturers need not monitor the CV System if it can be demonstrated that its design is unlikely to break, that disconnections within the system are unlikely to occur, or that disconnections of the CV system are not a part of any manufacturer specified repair procedures – total functional failure.

Appendix 12

ENGINE COOLING SYSTEM MONITORING

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

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

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

- Engine coolant temperature (thermostat): ability to reach the highest temperature required in the manufacturer specified conditions (e.g. time, etc…) to enable any other emission-related OBD monitors. Manufacturers need not monitor the thermostat if its failure will not disable any other OBD monitors – performance monitor.
- Engine coolant temperature sensor (or equivalent): measurement ability for detecting the stabilized minimum temperature that is needed to initiate closed-loop/feedback control of all affected emission control systems (e.g., fuel system, EGR system) – performance monitor.

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

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

Appendix 13

EXHAUST GAS SENSOR MONITORING

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

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

- Sensor performance[27] [28]: sensor's ability to carry-out any designed emission control system functions – emission threshold monitoring.
- Sensor performance[27] [28]: sensor's ability to carry-out any designed OBD monitoring functions – performance monitor
- Sensor heaters: Monitor the performance of the exhaust gas sensor heater when the current or voltage drop in the heater circuit is no longer within the manufacturer's specified limits for normal operation (i.e., within the criteria required to be met by the component vendor for heater circuit performance at high mileage).

[27] i.e. physical characteristics, incl. voltage, resistance, impedance, current, response rate, amplitude, offset, or other characteristic(s)) of the sensor(s).

[28] To achieve this monitoring requirement, a model based approach utilizing only one sensor may be accepted by the certification authority

Appendix 14

IDLE SPEED CONTROL SYSTEM MONITORING

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

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

- idle fuel control system: the idle fuel control system ability to achieve the target idle speed or fuel injection quantity within +/-50 percent of the manufacturer-specified fuel quantity and engine speed tolerances – performance monitoring
- idle fuel control system: the idle fuel control system ability to achieve the target idle speed or fuelling quantity within an engine speed or fuelling quantity tolerance range required by the OBD system to enable any other OBD monitors – performance monitoring.

Annex 4

TECHNICAL COMPLIANCE REPORT

This report is issued by the certification authority, according to sections 6.3.3 and 7.3, after examination of an OBD system or an emission OBD family when that system or family complies with the requirements of this gtr as transposed by the regulation of the Contracting Party.

The exact reference (including its version number) of this gtr shall be included in this report. The exact reference (including its version number) to the regulation by which a Contracting Party has transposed this gtr shall be included in this report.

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

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

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

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

FINAL COMPLIANCE REPORT (example)

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

Regulation number / version / enforcement date.

This regulation transposes the following gtr:
GTR number / version / [-] date.

The technical compliance report encompasses N pages.

Place, Date: . . . . . .

Author (Name and signature)
[Certification Authority (Name, stamp, and, when required by the Contracting Party accreditation number)]

Appendix 1 to the technical compliance report (example)

INFORMATION CONCERNING THE OBD SYSTEM

1. Type of requested certification

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

2. Information concerning the OBD system

Certification of an individual OBD system	
- type(s) 29/ of the engine system family (where applicable, see paragraph C.6.1), or type(s) 29/ of the single engine system(s)	. . . .
- OBD description (issued by the manufacturer): reference & date	. . . .
Certification of an emission OBD family	
- List of the engine families concerned by the emission OBD family (when applicable, see paragraph C.6.1)	. . . .
- Type 29/ of the parent engine system within the emission OBD family	. . . .
- List of the engine types 29/ within the emission OBD family	. . . .
- OBD description (issued by the manufacturer): reference & date	. . . .
Certification of an OBD system as member of a certified emission OBD family	
- List of the engine families concerned by the emission OBD family (when applicable, see paragraph C.6.1)	. . . .
- Type 29/ of the parent engine system within the emission OBD family	. . . .
- List of the engine types 29/ within the emission OBD family	. . . .
- Name of the engine system family concerned by the new OBD system (when applicable)	. . . .
- Type 29/ of the engine system concerned by the new OBD system	. . . .
- Extended OBD description (issued by the manufacturer): reference & date	. . . .

29 as reported in the certification document

Extension to include a new engine system into an emission OBD family	
- List (extended if necessary) of the engine families concerned by the emission OBD family (when applicable, see paragraph C.6.1)	. . . .
- List (extended if necessary) of the engine types 29/ within the emission OBD family	. . . .
- Actualised (new or unchanged) type29/ of the parent engine system within the emission OBD family	. . . .
- Extended OBD description (issued by the manufacturer): reference & date	. . . .
Extension to address a design change that affects the OBD system	
- List of the engine families (when applicable) concerned by the design change	. . . .
- List of the engine types 29/ concerned by the design change	. . . .
- Actualised (when applicable, new or unchanged) type 29/ of the parent engine system within the emission OBD family	. . . .
- Modified OBD description (issued by the manufacturer): reference & date	. . . .
Extension to address a malfunction reclassification	
- List of the engine families (when applicable) concerned by the reclassification	. . . .
- List of the engine types 29/ concerned by the reclassification	. . . .
- Modified OBD description (issued by the manufacturer): reference & date	. . . .

Appendix 2 to the technical compliance report (example)

INFORMATION CONCERNING THE CONFORMITY OF THE OBD SYSTEM

1. Documentation package

The elements provided by the manufacturer in the documentation package of the emission OBD family, is complete and complies with the requirements of paragraph 8. of module B of this gtr, on the following issues: - documentation associated with each monitored component or system - documentation associated with each DTC - documentation associated with the malfunction classification - documentation associated with the emission OBD family	 YES / NO YES / NO YES / NO YES / NO
The documentation required in paragraph 8.2 of this gtr for installing an OBD system in a vehicle has been provided by the manufacturer in the documentation package, is complete, and complies with the requirements of this gtr	YES / NO
The installation of the engine system equipped with the OBD system complies with annex 1 of this gtr Note: this statement applies only in the case the engine manufacturer has not provided the documentation required in paragraph 8.2, or if compliance of the installation is required by the Contracting Party,	YES / NO / Non applicable

2. Content of the documentation

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

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

Appendix 3 to the technical compliance report (example)

INFORMATION CONCERNING DEFICIENCIES

Number of deficiencies of OBD system	(ex: 4 deficiencies)
The deficiencies comply with the requirements of paragraph 6.4. of this gtr	YES / NO
Deficiency Nr.1 - Object of the deficiency - Period of the deficiency	 ex: measuring of the Urea concentration (SCR) within defined tolerances ex: two years after the date of certification
(Description of deficiencies 2 to n-1)	
Deficiency Nr.n - Object of the deficiency - Period of the deficiency	 ex: measuring of NH3 concentration behind SCR system ex: three years after the date of certification

Appendix 4 to the technical compliance report (example)

DEMONSTRATION TESTS OF THE OBD SYSTEM

1. Test result of the OBD system

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

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

1.1. OBD system tested on the engine test-bed

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

2. Demonstration tests of the installation of the OBD system

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

2.1. Test result of the installation of the OBD system

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

2.2. Tested installation

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

Tested vehicle	
- Vehicle name (manufacturer and commercial names):	. . . .
- Vehicle type:	. . . .
- Vehicle Identification No. (VIN):	. . . .
Diagnostic tool (scan tool used for testing)	
- Manufacturer:	. . .
- Type:	. . . .
- Software / Version:	. . . .
Test information	
- Place and Date:	. . . .

Appendix 5 to the technical compliance report (example)

TEST PROTOCOL

OBD System Demonstration Test

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

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

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

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

Annex 5

FREEZE FRAME AND DATA STREAM INFORMATION

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

Table 1: ENGINE SPEED AND LOAD INFORMATION:

	Freeze frame	Data stream
Calculated load (engine torque as a percentage of maximum torque available at the current engine speed)	x	x
driver's demand engine torque (as a percentage of maximum engine torque),	x	x
actual engine torque (calculated as a percentage of maximum engine torque, e.g. calculated from commanded injection fuel quantity)	x	x
reference engine maximum torque		x
reference maximum engine torque as a function of engine speed,		x
engine coolant temperature (or equivalent)	x	x
engine speed	x	x
time elapsed since engine start	x	x

Table 2: OTHER INFORMATION,
if used by the emission or the OBD system to enable or disable any OBD monitors

	Freeze frame	Data stream
fuel level	x	x
engine oil temperature	x	x
vehicle speed	x	x
barometric pressure (directly measured or estimated)	x	x
engine control computer system voltage (for the main control chip)	x	x

Table 3: OTHER INFORMATION,
if the engine is so equipped, senses or calculates the information:

	Freeze frame	Data stream

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