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Heavy duty vehicles:
UN Regulations Nos. 49 (Emissions of compression ignition and positive ignition (LPG and CNG) engines) and 132 (Retrofit Emissions Control devices (REC))

Proposal for a new Supplement to the 07 series of amendments to UN Regulation No. 49 (Emissions of compression ignition and positive ignition (LPG and CNG) engines)

Submitted by the experts from the Task Force AVRS *

This document proposes a new Supplement to the original version of UN Regulation No. 49. The new supplement intends to bring this Regulation up to date in the sense of provisions for automated vehicles and automated driving systems. The modifications to the current text of the Regulation are marked in bold for new or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2026 as outlined in proposed programme budget for 2026 (A/80/6 (Sect. 20), table 20.7), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

I. Proposal

Footnote 1, amend to read:

"[1] As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.~~3, para. 2~~**8** – ~~www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html~~**https://unece.org/transport/vehicle-regulations/wp29/resolutions**"

Paragraph 2.35., amend to read*:*

"2.35. "Malfunction indicat**ion**~~or~~" (MI) means an indicator which is part of the alert system and which clearly informs the driver of the vehicle **and/or sends a signal to the ADS[1],** in the event of a malfunction;"

Paragraph 2.55., amend to read:

"2.55. "Reference mass" means the mass of the vehicle in running order less the uniform mass of the driver of 75 kg **,** and increased by a uniform mass of 100 kg;

For vehicles of categories X and Y[1] the mass of the driver shall not be subtracted;"

Paragraph 2.62., amend to read:

"2.62. "Unladen mass" means the mass of the vehicle in running order without the uniform mass of the driver of 75 kg**,** passengers or load, but with the fuel tank 90 per cent full and the usual set of tools and spare wheel on board, where applicable.

For vehicles of category X and category Y the mass of the driver shall not be subtracted;"

Paragraph 3.1.3., amend to read:

"3.1.3. Together with the application, the manufacturer shall provide a documentation package that fully explains any element of design which affects emissions, the emission control strategy of the engine system, the means by which the engine system controls the output variables which have a bearing upon emissions, whether that control is direct or indirect, anti-tampering measures and fully explains the **reagent** warning and **reagent** inducement system required by paragraphs 4. and 5. of Annex 11.

…"

Paragraph 3.2.3., amend to read:

"3.2.3. The manufacturer shall provide a documentation package that fully explains the elements of the **reagent** warning and **reagent** inducement system that is on board of the vehicle and required by Annex 11. This documentation package shall be provided in accordance with paragraph 3.1.3."

Paragraph 3.3.3., amend to read:

"3.3.3. The manufacturer shall provide a documentation package that fully explains any element of design which affects emissions, the emission control strategy of the engine system, the means by which the engine system controls the output variables which have a bearing upon emissions, whether that control is direct or indirect, and fully explains the **reagent** warning and **reagent** inducement system required by Annex 11. This documentation package shall be provided in accordance with paragraph 3.1.3."

Footnote 5, amend to read:

"[3] The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.**8**~~2/Amend.1~~ -

~~www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html~~**https://unece.org/transport/vehicle-regulations/wp29/resolutions**"

Paragraphs 5.1.4.1. to 5.1.4.3. amend to read:

"5.1.4.1. The documentation package required by paragraph 3. of this Regulation enabling the Type Approval Authority to evaluate the emission control strategies and the systems on-board the vehicle and engine to ensure the correct operation of NO x control measures, as well as the documentation packages required in Annex 10 (off-cycle emissions), Annexes 9A and 9B (OBD) and Annex 15 to this Regulation (dual-fuel engines), shall include the following information:

(a) A full description of the **reagent** inducement system required by Annex 11, including the associated monitoring strategies;

(b) The description of the anti-tampering measures considered in paragraph 3.1.4.(b) and in paragraph 3.2.4.(a).

5.1.4.2. The formal documentation package may be brief, provided that it exhibits evidence that all outputs permitted by a matrix obtained from the range of control of the individual unit inputs have been identified. The documentation shall describe the functional operation of the **reagent** inducement system required by Annex 11, including the parameters necessary for retrieving the information associated with that system. This material shall be retained by the Type Approval Authority.

5.1.4.3. The extended documentation package shall include:

(a) Information on the operation of all AES and BES, including a description of the parameters that are modified by any AES and the boundary conditions under which the AES operate, and indication of which AES and BES are likely to be active under the conditions of the test procedures set out in Annex 10;

(b) A description of the fuel system control logic, timing strategies and switch points during all modes of operation;

(c) A full description of the **reagent** inducement system required in Annex 11, including the associated monitoring strategies;

(d) The description of the anti-tampering measures considered in paragraph 3.1.4. (b) and in paragraph 3.2.4. (a)."

Annex 1, table part 1 Rows 3.2.12.2.8.2. and 3.2.12.2.8.2.1, amend to read:

"

3.2.12.2.8.2.	~~Driver~~ **reagent** inducement system						
3.2.12.2.8.2.1	Engine with permanent deactivation of the ~~driver~~ **reagent** inducement, for use by the rescue services or in vehicles designed and constructed for use by the armed services, civil defence, fire services and forces responsible for maintaining public order: Yes/No [1]						

"

Annex 1, table part 2 Rows 3.2.12.2.8.2. and 3.2.12.2.8.2.1, amend to read:

"

3.2.12.2.8.2.	~~Driver~~ **reagent** inducement system						
3.2.12.2.8.2.1	Engine with permanent deactivation of the ~~driver~~ **reagent** inducement, for use by the rescue services or in vehicles designed and constructed for use by the armed services, civil defence, fire services and forces responsible for maintaining public order: Yes/No [1]						

"

Annex 2B, footnote 4, amend to read:

____

"[4] Classified according to definitions listed in "Consolidated Resolution on the Construction of Vehicles (R.E.3)" - ECE/TRANS/WP.29/78/Rev.**8**~~2, para.2~~. **- https://unece.org/transport/vehicle-regulations/wp29/resolutions**"

Annex 2D, paragraph 3., amend to read:

"3. The AES documentation package shall be limited to 100 pages and shall include all the main elements to allow the approval authority to assess the AES (according to the requirements of Appendix 2 to Annex 10, the effectiveness of the **reagent** inducement system and the anti-tampering measures. The package may be complemented with annexes and other attached documents, containing additional and complementary elements, if necessary. The manufacturer shall send a new version of the AES documentation package to the approval authority every time changes are introduced to the AES. The new version shall be limited to the changes and their effect. The new version of the AES shall be evaluated and approved by the approval authority."

Annex 2D, table 1 paragraph 4., amend to read:

"4. Description of the **reagent** inducement system, including the associated monitoring strategies"

Annex 7, footnote 1, amend to read:

____

"[1] As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3) - ECE/TRANS/WP.29/78/Rev.**8**~~2, para.2~~. - **https://unece.org/transport/vehicle-regulations/wp29/resolutions**"

Annex 8, paragraph 1.2., insert new paragraph to read:

"**1.2. Special provisions for vehicles equipped with an ADS**

For vehicles of categories X and Y, all tests in this annex shall be conducted, and all respective requirements shall be fulfilled. The in-service conformity test shall be conducted using dedicated methods, which may include assigning way points to define the test route, selection of different modes or any other method subject to agreement between the vehicle manufacturer and the Type Approval Authority, ensuring that the test accurately reflects normal driving patterns.

For vehicles equipped with an ADS, other than those of categories X and Y, the in-service conformity test shall be performed at least in the manual

driving mode. Tests do not have to be performed in ADS mode providing the manufacturer can demonstrate to the Type Approval Authority that the same level of compliance is achieved whilst an ADS feature is active. However, testing to verify this shall be performed at the request of the Type Approval Authority."

Annex 8, paragraph 2.1., amend to read:

"2.1. The conformity of in-service vehicles or engines of an engine family shall be demonstrated by testing vehicles on the road operated over their normal driving patterns, conditions and payloads. The in-service conformity test shall be representative for vehicles operated on their real driving routes, with their normal payload and with the usual professional driver **or the ADS (as applicable)** of the vehicle. When the vehicle is operated by a driver other than the usual professional driver of the particular vehicle, this alternative driver shall be skilled and trained to operate vehicles of the category subject to be tested."

Annex 8 Paragraph 4.1., amend to read:

"4.1. Vehicle payload

Normal payload is a payload between 10 and 100 per cent of the maximum payload.

The maximum payload is the difference between technically permissible maximum laden mass of the vehicle and the mass of the vehicle in running order as specified in Annex 3 to Special Resolution No. 1 (ECE/TRANS/WP.29/1045, as amended by Amendments 1,~~ and~~ 2 **and 3**).

…"

Annex 9B, paragraph 3.1., amend to read:

"3.1. "Alert system" means a system on-board the vehicle which informs the driver of the vehicle **and/or sends a signal to the ADS** or any other interested party that the OBD system has detected a malfunction."

Annex 9B, paragraph 4., amend to read:

"4. General requirements

In the context of this annex, 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.

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 Type Approval Authority will recognize 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 **or to the ADS (as applicable)**.

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)."

Annex 9B, paragraph 4.7.3.3., amend to read:

"4.7.3.3. Connector location

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.

The Type Approval Authority may 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, e.g. the location as described in ISO 15031 series of standards.

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 Appendix 6 to this annex, only the connector required by this annex shall be clearly labelled "OBD" to distinguish it from other similar connectors.

For vehicles of categories X and Y, all applicable provisions of this paragraph shall apply. For the purpose of this paragraph, “driver’s side” may be understood as either side of the vehicle. In the case of vehicles not equipped with a steering wheel, the connector shall be positioned at a height such that it is outside the normal field of view of the occupant seated nearest to the connector."

Annex 9B, Appendix 5, Table 2, first row, amend to read:

"~~Driver’s d~~**D**emand**ed** engine torque (as a percentage of maximum engine torque)"

Annex 9C, paragraph 5.4., amend to read:

"5.4. Requirements for incrementing the general denominator

…

(c) Continuous vehicle operation at idle (e.g., ~~accelerator pedal released by driver~~**no acceleration demand or engine speed demand beyond idle,** and either vehicle speed less than or equal to 1.6 km/h or engine speed less than or equal to 200 min-1 above normal warmed-up idle) for greater than or equal to 30 seconds while under the conditions specified in the above subparagraph (a)."

Annex 10, Appendix 1, paragraph A.1.3.5., amend to read:

"A.1.3.5. Trip and operational requirements
The trip and operational requirements shall be those described in paragraphs 4.5. to 4.6.8. of Annex 8.

In the case of vehicles equipped with an ADS, the special provisions laid down in paragraph 1.2. to Annex 8 shall apply."

Annex 11, paragraph 1., amend to read:

"1. Introduction

This annex sets out the requirements to ensure the correct operation of NOx control measures. It includes requirements for vehicles that rely on the use of a reagent in order to reduce emissions.

Whilst an ADS feature is active, whenever this annex mentions the driver being informed of reagent and reagent inducement warnings, it shall be understood as warning signals sent to the ADS. "

Annex 11, footnote 1, amend to read:

"[1] As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.**8**~~3, para. 2~~. - ~~www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html~~**https://unece.org/transport/vehicle-regulations/wp29/resolutions**"

Annex 11, paragraph 2.1.2.2.3.*,* amend to read:

"2.1.2.2.3. The ~~driver~~**reagent** warning system referred to in paragraph 4., 7. and 8. of this Annex shall be understood as the ~~driver~~ warning system in paragraph 3. of Appendix 6 to the 07 series of amendments to Regulation No. 83."

Annex 11, paragraph 2.2.3. and 2.2.4., amend to read:

"2.2.3. Detailed written information fully describing the functional operation characteristics of the ~~driver~~ **reagent** warning system as provided in accordance with paragraph 4. and of the ~~driver~~ **reagent** inducement system as provided in accordance with paragraph 5. shall be submitted to the Type Approval Authority at the time of application for the type approval.

2.2.4. When a manufacturer applies for an approval of an engine or engine family as a separate technical unit, it shall include in the documentation package referred to in paragraphs 3.1.3., 3.2.3. or 3.3.3. of this Regulation the appropriate requirements that will ensure that the vehicle, when used on the road or elsewhere as appropriate, will comply with the requirements of this annex. This documentation shall include the following:

(a) The detailed technical requirements including the provisions ensuring the compatibility with the monitoring, **reagent** warning, and **reagent** inducement systems present in the engine system for the purpose of complying with the requirements of this annex;

(b) The verification procedure to be complied with for installation of the engine in the vehicle.

…"

Annex 11, paragraphs 2.4.3.1. and 2.4.3.2., amend to read:

"2.4.3.1. The ~~driver~~**reagent** warning system described in paragraph 4. shall be activated if no reagent dosing occurs at an ambient temperature ≤ 266 K (-7 °C).

2.4.3.2. The severe **reagent** inducement system described in paragraph 5.4. shall be activated if no reagent dosing occurs at an ambient temperature ≤ 266 K (-7 °C) within a maximum of 70 minutes after vehicle start."

Annex 11, paragraph 3.1., amend to read:

"3.1. The manufacturer shall furnish or cause to be furnished to all owners of new vehicles or new engines type-approved in accordance with this Regulation written instructions about the emission control system and its correct operation.

Those instructions shall state that if the vehicle emission control system is not functioning correctly, the driver **or the ADS (as applicable)** will be informed of a problem by the ~~driver~~ **reagent** warning system, and that operation of the ~~driver~~ **reagent** inducement system as a consequence of ignoring this warning will result in the vehicle being unable to efficiently conduct its mission."

Annex 11, paragraph 3.7., amend to read:

"3.7. The instructions shall explain how the **reagent** warning system and ~~driver~~ **reagent** inducement systems work. In addition, the consequences, in terms of vehicle performance and fault logging, of ignoring the warning system and not replenishing the reagent or rectifying a problem shall be explained."

Annex 11, paragraph 4., amend to read:

"4. ~~Driver~~**Reagent** Warning System"

Annex 11, paragraph 4.1., amend to read:

"4.1. The vehicle shall include a ~~driver~~**reagent** warning system using visual alarms that informs the driver **or sends a signal to the ADS (as applicable),** when a low reagent level, incorrect reagent quality, too low a rate of reagent consumption, or a malfunction, has been detected that may be due to tampering and that will lead to operation of the ~~driver~~**reagent** inducement system if not rectified in a timely manner. The warning system shall also be active when the ~~driver~~**reagent** inducement system described in paragraph 5. has been activated."

Annex 11, paragraph 4.3., amend to read:

"4.3. The ~~driver~~**reagent** warning system may display short messages, including messages indicating clearly the following: (a) The remaining distance or time before activation of the low-level or severe **reagent** inducements; (b) The level of torque reduction; (c) The conditions under which vehicle disablement can be cleared. The system used for displaying the messages referred to in this point may be the same as the one used for OBD or other maintenance purposes.

4.4. At the choice of the manufacturer, the **reagent** warning system may include an audible component to alert the driver **or ADS (as applicable)**. The cancelling of audible warnings by the driver is permitted."

Annex 11, paragraphs 4.5. and 4.6., amend to read:

"4.5. The ~~driver~~**reagent** warning system shall be activated as specified in paragraphs 6.2., 7.2., 8.4., and 9.3.

4.6. The ~~driver~~**reagent** warning system shall be deactivated when the conditions for its activation have ceased to exist. The ~~driver~~**reagent** warning system shall not be automatically deactivated without the reason for its activation having been remedied."

Annex 11, paragraphs 4.8. to 4.10., amend to read:

"4.8. A facility to permit the driver **(if applicable)** to dim the visual alarms provided by the warning system may be provided on vehicles for use by the rescue services or on vehicles designed and constructed for use by the armed services, civil defence, fire services and forces responsible for maintaining public order.

4.9. Details of the ~~driver~~**reagent** warning system activation and deactivation procedures are specified in Appendix 2 to this annex.

4.10. As part of the application for type approval under this Regulation, the manufacturer shall demonstrate the operation of the ~~driver~~**reagent** warning system, as specified in Appendix 1 to this annex."

Annex 11, paragraphs 5. to 5.4.1., amend to read:

"5. ~~Driver~~ **reagent** Inducement system

5.1. The vehicle shall incorporate a two-stage ~~driver~~ **reagent** inducement system starting with a low-level inducement (a performance restriction) followed by a severe inducement (effective disablement of vehicle operation).

5.2. The requirement for a ~~driver~~ **reagent** inducement system shall not apply to engines or vehicles for use by the rescue services or to engines or on vehicles designed and constructed for use by the armed services, civil defence, fire services and forces responsible for maintaining public order. Permanent deactivation of the ~~driver~~ **reagent** inducement system shall only be done by the engine or vehicle manufacturer.

5.3. Low-level **reagent** inducement system

The low-level **reagent** inducement system shall reduce the maximum available engine torque across the engine speed range by 25 per cent between the peak torque speed and the governor breakpoint as described in Appendix 3 to this annex. The maximum available reduced engine torque below the peak torque speed of the engine before imposition of the torque reduction shall not exceed the reduced torque at that speed.

The low-level **reagent** inducement system shall be activated when the vehicle becomes stationary 2 for the first time after the conditions specified in paragraphs 6.3., 7.3., 8.5. and 9.4., have occurred.

5.4. Severe **reagent** inducement system

The vehicle or engine manufacturer shall incorporate at least one of the severe **reagent** inducement systems described in paragraphs 5.4.1. to 5.4.3. and the "disable on time limit" system described in paragraph 5.4.4.

5.4.1. A "disable after restart" system shall limit the vehicle speed to 20 km/h ("creep mode") after the engine has been shut down at the request of the driver ("key-off**") or the ADS, as applicable.**

…"

Annex 11, paragraph 5.5., amend to read:

"5.5. The ~~driver~~**reagent** inducement system shall be enabled as specified in paragraphs 6.3., 7.3., 8.5., and 9.4."

Annex 11, paragraph 5.5.1., amend to read:

"5.5.1. When the ~~driver~~**reagent** inducement system has determined that the severe inducement system shall be activated, the low-level **reagent** inducement system shall remain activated until the vehicle speed has been limited to 20 km/h ("creep mode")."

Annex 11, paragraphs 5.6. to 5.8., amend to read:

"5.6. The ~~driver~~**reagent** inducement system shall be deactivated when the conditions for its activation have ceased to exist. The ~~driver~~ **reagent** inducement system shall not be automatically deactivated without the reason for its activation having been remedied.

5.7. Details of the ~~driver~~**reagent** inducement system activation and deactivation procedures are described in Appendix 2 to this annex.

5.8. As part of the application for type approval under this Regulation, the manufacturer shall demonstrate the operation of the ~~driver~~**reagent** inducement system, as specified in Appendix 1 to this annex."

Annex 11, paragraphs 6.1. to 6.2.1., amend to read:

"6.1. The vehicle shall include a specific indicator on the dashboard that clearly informs the driver of the level of reagent in the reagent storage tank. The minimum acceptable performance level for the reagent indicator is that it shall continuously indicate the reagent level whilst the ~~driver~~**reagent** warning system referred to in paragraph 4. is activated to indicate problems with reagent availability. The reagent indicator may be in the form of an analogue or digital display, and may show the level as a proportion of the full tank capacity, the amount of remaining reagent, or the estimated driving distance remaining.

6.2. Activation of the ~~driver~~**reagent** warning system

6.2.1. The ~~driver~~**reagent** warning system specified in paragraph 4. shall be activated when the level of reagent is less than 10 per cent of the capacity of the reagent tank or a higher percentage at the choice of the manufacturer."

Annex 11, paragraph 6.2.3., amend to read:

"6.2.3. The ~~driver~~**reagent** warning system does not initially need to be continuously activated, however activation shall escalate in intensity so that it becomes continuous when the level of the reagent is approaching a very low proportion of the capacity of the reagent tank and the point where the ~~driver~~**reagent** inducement system will come into effect is approached. It shall culminate in a ~~driver~~ notification at a level that is at the choice of the manufacturer, but is sufficiently more noticeable than the point where the ~~driver~~**reagent** inducement system in paragraph 6.3. comes into effect."

Annex 11, paragraph 6.2.5., amend to read:

"6.2.5. It shall not be possible to turn off the ~~driver~~**reagent** warning system until the reagent has been replenished to a level not requiring its activation."

Annex 11, paragraph 6.3., amend to read:

"6.3. Activation of the ~~driver~~**reagent** inducement system

6.3.1. The low-level **reagent** inducement system described in paragraph 5.3. shall be enabled, and subsequently activated according to the requirements of that section, if the reagent tank level goes below 2.5 per cent of its nominally full capacity or a higher percentage at the choice of the manufacturer.

6.3.2. The severe **reagent** inducement system described in paragraph 5.4. shall be enabled, and subsequently activated according to the requirements of that section, if the reagent tank is empty (that is, the dosing system is unable to draw further reagent from the tank) or at any level below 2.5 per cent of its nominally full capacity at the discretion of the manufacturer.

6.3.3. It shall not be possible to turn off the low-level or severe ~~driver~~**reagent** inducement system until the reagent has been replenished to a level not requiring their respective activation."

Annex 11, paragraph 7.2., amend to read:

"7.2. Activation of the ~~driver~~**reagent** warning system. When the monitoring systems detects or, as appropriate, confirms that the reagent quality is incorrect, the

~~driver~~**reagent** warning system described in paragraph 4. shall be activated. When the warning system includes a message display system, it shall display a message indicating the reason for the warning (for example: "incorrect urea detected", "incorrect AdBlue detected", or "incorrect reagent detected")."

Annex 11, paragraph 7.3., amend to read:

"7.3. Activation of the ~~driver~~**reagent** inducement system

7.3.1. The low-level **reagent** inducement system described in paragraph 5.3. shall be enabled, and subsequently activated according to the requirements of that section, if the reagent quality is not rectified within 10 engine operating hours after the activation of the ~~driver~~**reagent** warning system described in paragraph 7.2.

7.3.2. The severe **reagent** inducement system described in paragraph 5.4. shall be enabled, and subsequently activated according to the requirements of that section, if the reagent quality is not rectified within 20 engine operating hours after the activation of the ~~driver~~**reagent** warning system described in paragraph 7.2.

7.3.3. The number of hours prior to activation of the **reagent** inducement systems shall be reduced in case of a repetitive occurrence of the malfunction, in accordance with the mechanism described in Appendix 2 to this annex."

Annex 11, paragraph 8.4., amend to read:

"8.4. Activation of the ~~driver~~**reagent** warning system

8.4.1. The ~~driver~~**reagent** warning system described in paragraph 4. shall be activated if a deviation of more than fifty per cent between the average reagent consumption and the average demanded reagent consumption by the engine system over a period to be defined by the manufacturer, which shall not be longer than the maximum period defined in paragraph 8.3.1., or, when applicable, paragraph 8.3.1.1., is detected. When the warning system includes a message display system, it shall display a message indicating the reason for the warning (for example: "urea dosing malfunction", "AdBlue dosing malfunction", or "reagent dosing malfunction).

8.4.2. The ~~driver~~**reagent** warning system described in paragraph 4. shall be activated in the case of interruption in reagent dosing. When the warning system includes a message display system, it shall display a message indicating an appropriate warning. This activation shall not be required where the interruption is demanded by the engine ECU because the vehicle operating conditions are such that the vehicle's emission performance does not require reagent dosing."

Annex 11, paragraph 8.5., amend to read:

"8.5. Activation of the ~~driver~~**reagent** inducement system

8.5.1. The low-level **reagent** inducement system described in paragraph 5.3. shall be enabled, and subsequently activated according to the requirements of that section, if an error in the reagent consumption or an interruption in reagent dosing is not rectified within 10 engine operating hours after the activation of the ~~driver~~**reagent** warning system specified in paragraphs 8.4.1. and 8.4.2.

8.5.2. The severe **reagent** inducement system described in paragraph 5.4. shall be enabled, and subsequently activated according to the requirements of that section, if an error in the reagent consumption or an interruption in reagent dosing is not rectified within 20 engine operating hours after the activation of the ~~driver~~**reagent** warning system in paragraphs 8.4.1. and 8.4.2.

8.5.3. The number of hours prior to activation of the **reagent** inducement systems shall be reduced in case of a repetitive occurrence of the malfunction in accordance with the mechanism described in Appendix 2 to this annex."

Annex 11, paragraph 9.3., amend to read:

"9.3. Activation of the ~~driver~~**reagent** warning system

The ~~driver~~**reagent** warning system described in paragraph 4. shall be activated in the case where any of the failures specified in paragraph 9.1. occurs, and shall indicate that an urgent repair is required. When the **reagent** warning system includes a message display system, it shall display a message indicating either the reason for the warning (for example, "reagent dosing valve disconnected", or "critical emission failure")."

Annex 11, paragraph 9.4. and subparagraphs, amend to read:

"9.4. Activation of the ~~driver~~**reagent** inducement system

9.4.1. The low-level **reagent** inducement system described in paragraph 5.3. shall be enabled, and subsequently activated according to the requirements of that section, if a failure specified in paragraph 9.1. is not rectified within 36 engine operating hours after the activation of the ~~driver~~**reagent** warning system in paragraph 9.3.

9.4.2. The severe **reagent** inducement system described in paragraph 5.4. shall be enabled, and subsequently activated according to the requirements of that section, if a failure specified in paragraph 9.1. is not rectified within 100 engine operating hours after the activation of the ~~driver~~**reagent** warning system in paragraph 9.3.

9.4.3. The number of hours prior to activation of the **reagent** inducement systems shall be reduced in case of a repetitive occurrence of the malfunction in accordance with the mechanism described in Appendix 2 to this annex."

Annex 11, Appendix 1, paragraph A.1.1.1. amend to read:

"A.1.1.1. The manufacturer shall submit to the Type Approval Authority a complete documentation package justifying the compliance of the SCR system with the requirements of this annex as regards its capabilities for monitoring and activation of the ~~driver~~**reagent** warning and **reagent** inducement system, which may include:"

Annex 11, Appendix 1, paragraph A.1.1.2. amend to read:

"A.1.1.2. Compliance with the requirements of this annex shall be demonstrated during type approval by performing, as illustrated in Table 1 and specified in this Appendix, the following demonstrations:

(a) A demonstration of the **reagent** warning system activation;

(b) A demonstration of the low level **reagent** inducement system activation;

(c) A demonstration of the severe **reagent** inducement system activation."

Annex 11, Appendix 1, table 1 amend to read:

"

	Demonstration elements
Warning system activation specified in paragraph A.1.3.	4 activation tests (incl. lack of reagent) Supplementary demonstration elements, as appropriate
Low-level **reagent** inducement activation	2 activation tests (incl. lack of reagent) Supplementary demonstration elements

specified in paragraph A.1.4	1 torque reduction test
Severe **reagent** inducement activation specified in paragraph A.1.5.	2 activation tests (incl. lack of reagent) Supplementary demonstration elements, as appropriate Demonstration elements of correct vehicle behavior during inducement

"

Annex 11, Appendix 1, paragraph A.1.3. amend to read:

"A.1.3. Demonstration of the **reagent** warning system activation

A.1.3.1. The compliance of the **reagent** warning system activation shall be demonstrated by performing one test for each of the failure categories considered in paragraphs 6. to 9. of this annex such as: lack of reagent, low reagent quality, low reagent consumption, failure of components of the monitoring system.

A.1.3.2. Selection of the failures to be tested

A.1.3.2.1. For the purpose of demonstrating the activation of the **reagent** warning system in case of a wrong reagent quality, a reagent shall be selected with a concentration of the active ingredient equal to or higher than the minimum acceptable reagent concentration CD min, communicated by the manufacturer in accordance with the requirements of paragraph 7.1.1. of this annex.

A.1.3.2.2. For the purpose of demonstrating the activation of the **reagent** warning system in the case of an incorrect rate of reagent consumption, it shall be sufficient to arrange an interruption of the dosing activity.

A.1.3.2.2.1. Where activation of the **reagent** warning system has been demonstrated by interruption of the dosing activity, the manufacturer shall, in addition, present the Type Approval Authority with evidence such as algorithms, functional analyses, the results of previous tests, etc. to show that the warning system will activate correctly in the case of an incorrect rate of reagent consumption due to other causes.

A.1.3.2.3. For the purpose of demonstrating the activation of the **reagent** warning system in case of failures that may be attributed to tampering, as defined in paragraph 9. Of this annex, the selection shall be performed in accordance with the following requirements:

…

A.1.3.3.1. For the purposes of this demonstration of the activation of the **reagent** warning system a separate test shall be performed for each of the failures considered in paragraph A.1.3.1.

…

A.1.3.3.6. For the purpose of demonstrating the activation of the **reagent** warning system in case of lack of reagent availability, the engine system shall be operated over one or more operating sequences at the discretion of the manufacturer.

…

A.1.3.3.6.2. The **reagent** warning system is deemed to have performed in the correct manner if the following conditions are met simultaneously:

(a) The warning system has been activated with a reagent availability greater or equal to 10 per cent of the capacity of the reagent tank;

(b) The "continuous" **reagent** warning system has been activated with a reagent availability greater or equal to the value declared by the manufacturer according to the provisions of paragraph 6. of this annex.

A.1.3.4. The demonstration of the **reagent** warning system activation is deemed to be accomplished for reagent level events if, at the end of each demonstration test performed according to paragraph A.1.3.2.1., the **reagent** warning system has been properly activated.

A.1.3.5. The demonstration of the **reagent** warning system activation is deemed to be accomplished for DTC triggered events if, at the end of each demonstration test performed according to paragraph A.1.3.2.1., the warning system has been properly activated and the DTC for the selected failure has got the status shown in Table 1 in Appendix 2 to this annex."

Annex 11, Appendix 1, paragraphs A.1.4. to A.1.4.6.4., amend to read:

"A.1.4. Demonstration of the **reagent** inducement system

A.1.4.1. The demonstration of the **reagent** inducement system shall be done by tests performed on an engine test bench.

A 1.4.1.1. Any additional vehicle components or sub-systems, such as ambient temperature sensors, level sensors, and ~~driver~~**reagent** warning and information systems, that are required in order to perform the demonstrations shall be connected to the engine system for that purpose, or shall be simulated, to the satisfaction of the Type Approval Authority.

…

A.1.4.2. The test sequence shall demonstrate the activation of the **reagent** inducement system in case of lack of reagent and in case of one of the failures defined in paragraphs 7., 8., or 9. of this annex.

A.1.4.3. For the purpose of this demonstration,

(a) The Type Approval Authority shall select, in addition to the lack of reagent, one of the failures defined in paragraphs 7., 8. or 9. of this annex that has been previously used in the demonstration of the warning system;

(b) The manufacturer shall be permitted to simulate, in agreement with the Type Approval Authority, the achievement of a certain number of operating hours;

(c) The achievement of the torque reduction required for low-inducement may be demonstrated at the same time as the general engine performance approval process performed in accordance with this Regulation. Separate torque measurement during the **reagent** inducement system demonstration is not required in this case. The speed limitation required for severe inducement shall be demonstrated in accordance with the requirements of paragraph 5. of this annex.

A.1.4.4. The manufacturer shall, in addition, demonstrate the operation of the **reagent** inducement system under those failure conditions defined in paragraphs 7., 8. or 9. of this annex which have not been chosen for use in demonstration tests described in paragraphs A.1.4.1., A.1.4.2. and A.1.4.3. These additional demonstrations may be performed by presentation to the Type Approval Authority of a technical case using evidence such as algorithms, functional analyses, and the results of previous tests.

…

A.1.4.5. Demonstration test of the low level **reagent** inducement system

A.1.4.5.1. This demonstration starts when the **reagent** warning system, or when appropriate "continuous" **reagent** warning system, has been activated as a result of the detection of a failure selected by the Type Approval Authority.

A.1.4.5.2. When the system is being checked for its reaction to the case of lack of reagent in the tank, the engine system shall be run until the reagent availability has reached a value of 2.5 per cent of the nominal full capacity of the tank or the value declared by the manufacturer in accordance with paragraph 6.3.1. of this annex at which the low-level **reagent** inducement system is intended to operate.

…

A.1.4.5.3. When the system is checked for its reaction in the case of a failure other than a lack of reagent in the tank, the engine system shall be run for the relevant number of operating hours indicated in Table 2 of Appendix 2 or, at the choice of the manufacturer, until the relevant counter has reached the value at which the low-level **reagent** inducement system is activated.

A.1.4.5.4. The demonstration of the low level **reagent** inducement system shall be deemed to be accomplished if, at the end of each demonstration test performed in accordance with paragraphs A.1.4.5.2. and A.1.4.5.3., the manufacturer has demonstrated to the Type Approval Authority that the engine ECU has activated the torque reduction mechanism.

A.1.4.6. Demonstration test of the severe **reagent** inducement system

A.1.4.6.1. This demonstration shall start from a condition where the low-level **reagent** inducement system has been previously activated, and may be performed as a continuation of the tests undertaken to demonstrate the low-level **reagent** inducement system.

A.1.4.6.2. When the system is checked for its reaction in the case of lack of reagent in the tank, the engine system shall be run until the reagent tank is empty (that is, until the dosing system cannot draw further reagent from the tank), or has reached the level below 2.5 per cent of nominal full capacity of the tank at which the manufacturer has declared that the severe **reagent** inducement system will be activated.

…

A.1.4.6.3. When the system is checked for its reaction in the case of a failure that is not a lack of reagent in the tank, the engine system shall then be run for the relevant number of operating hours indicated in Table 2 of Appendix 2 or, at the choice of the manufacturer, until the relevant counter has reached the value at which the severe **reagent** inducement system is activated.

A.1.4.6.4. The demonstration of the severe **reagent** inducement system shall be deemed to be accomplished if, at the end of each demonstration test performed in accordance with paragraphs A.1.4.6.2. and A.1.4.6.3. the manufacturer has demonstrated to the Type Approval Authority that the required vehicle speed limitation mechanism has been activated."

Annex 11, Appendix 1, paragraphs A.1.5. to A.1.5.4.4., amend to read:

"A.1.5. Demonstration of the vehicle speed limitation following activation of the severe **reagent** inducement system

A.1.5.1. The demonstration of the vehicle speed limitation following activation of the severe **reagent** inducement system shall be performed by the presentation to the Type Approval Authority of a technical case using evidence such as algorithms, functional analyses, and the result of previous tests.

…

A.1.5.3. If the Type Approval Authority is not satisfied with the evidence of proper operation of the severe **reagent** inducement system that is provided by the manufacturer, the Type Approval Authority may request a demonstration on a single representative vehicle in order to confirm proper operation of the system. The vehicle demonstration shall be performed in accordance with the requirements of paragraph A.1.5.4.

A.1.5.4. Additional demonstration for confirming the effect of activation of the severe **reagent** inducement system on a vehicle

A.1.5.4.1. This demonstration shall be performed at the request of the Type Approval Authority when it is not satisfied with the evidence of proper operation of the severe **reagent** inducement system provided by the manufacturer. This demonstration shall be performed at the earliest opportunity in agreement with the Type Approval Authority.

…

A.1.5.4.3. The **reagent** inducement system shall be brought by the manufacturer to a state where the low-level **reagent** inducement system has been activated and the severe **reagent** inducement system has not yet been activated.

A.1.5.4.4. The vehicle shall be operated until the counter associated with the selected failure has reached the relevant number of operating hours indicated in Table 2 of Appendix 2 or, as appropriate, until either the reagent tank is empty or, has reached the level below 2.5 per cent of nominal full capacity of the tank at which the manufacturer has chosen to activate the severe **reagent** inducement system.

…"

Annex 11, Appendix 2, heading, amend to read:

"Description of the ~~driver~~reagent warning and inducement activation and deactivation mechanisms"

Annex 11, Appendix 2, paragraph A.2.1., amend to read:

"A.2.1. To complement the requirements specified in this annex concerning the ~~driver~~**reagent** warning and inducement activation and deactivation mechanisms, this Appendix specifies the technical requirements for an implementation of those activation and deactivation mechanisms consistent with the OBD provisions of Annex 9B.

All definitions used in Annex 9B are applicable to this appendix."

Annex 11, Appendix 2, paragraph A.2.2., amend to read:

"A.2.2. Activation and deactivation mechanisms of the ~~driver~~**reagent** warning system

A.2.2.1. The ~~driver~~**reagent** warning system shall be activated when the diagnostic trouble code (DTC) associated with a malfunction justifying its activation has the status defined in Table 1.

Table 1

Activation of the ~~driver~~**reagent** warning system

…"

Annex 11, Appendix 2, paragraph A.2.2.1.1., amend to read:

"A.2.2.1.1. If the counter associated with the relevant failure is not at zero, and is consequently indicating that the monitor has detected a situation where the malfunction may have occurred for a second or subsequent time, the ~~driver~~**reagent** warning system shall be activated when the DTC has the status "potential"."

Annex 11, Appendix 2, paragraph A.2.2.2., amend to read:

"A.2.2.2. The ~~driver~~**reagent** warning system shall be deactivated when the diagnostic system concludes that the malfunction relevant to that warning is no longer present or when the information, including DTCs relative to the failures, justifying its activation is erased by a scan tool."

Annex 11, Appendix 2, paragraph A.2.2.2.1.1,. amend to read:

"A.2.2.2.1.1. Erasing of information, including DTCs relative to failures justifying the activation of a ~~driver~~**reagent** warning signal and of their associated data, by means of a scan tool shall be performed in accordance with Annex 9B."

Annex 11, Appendix 2, paragraphs A.2.3. and A.2.3.1., amend to read:

"A.2.3. Activation and deactivation mechanism of the ~~driver~~**reagent** inducement system

A.2.3.1. The ~~driver~~**reagent** inducement system shall be activated when the warning system is active and the counter relevant to the type of malfunction justifying its activation has reached the value specified in Table 2."

Annex 11, Appendix 2, paragraph A.2.3.2., amend to read:

"A.2.3.2. The ~~driver~~**reagent** inducement system shall be deactivated when the system no longer detects a malfunction justifying its activation, or if the information, including the DTCs, relative to the failures justifying its activation has been erased by a scan tool or maintenance tool."

Annex 11, Appendix 2, paragraph A.2.3.3., amend to read:

"A.2.3.3. The ~~driver~~**reagent** warning and **reagent** inducement systems shall be immediately activated or deactivated as appropriate in accordance with the provisions of paragraph 6. of this annex after assessment of the reagent quantity in the reagent tank. In that case, the activation or deactivation mechanisms shall not depend upon the status of any associated DTC."

Annex 11, Appendix 2, paragraph A.2.4.2.1.2.1., amend to read:

"A.2.4.2.1.2.1. If the counter stops counting when the severe **reagent** inducement system is active, the counter shall be kept frozen at the value defined in Table 2."

Annex 11, Appendix 2, paragraphs A.2.5.1 and A.2.5.2., amend to read:

"A.2.5.1. This paragraph illustrates the activation and deactivation and counter mechanisms for some typical cases. The figures and descriptions given in paragraphs A.2.4.2., A.2.4.3. and A.2.4.4. are provided solely for the purposes of illustration in this annex and should not be referenced as examples of either the requirements of this Regulation or as definitive statements of the processes involved. For simplification purposes, for example, the fact that the warning system will also be active when the **reagent** inducement system is active has not been mentioned in the illustrations given.

A.2.5.2. Figure 2 illustrates the operation of the activation and deactivation mechanisms when monitoring the reagent availability for five cases:

(a) Use case 1: ~~the driver continues operating~~ the vehicle **is operated** in spite of the **reagent** warning until vehicle operation is disabled;

(b) Repair case 1 ("adequate" refilling): ~~the driver refills~~ the reagent tank **is refilled** so that a level above the 10 per cent threshold is reached. **Reagent** w~~W~~arning and **reagent** inducement are de-activated;

(c) …"

Annex 11, Appendix 2, paragraph A.2.5.3., amend to read:

"A.2.5.3. Figure 3 illustrates three cases of wrong urea quality:

(a) Use case 1: ~~the driver continues operating~~ the vehicle **is operated** in spite of the **reagent** warning until vehicle operation is disabled;

(b) Repair case 1 ("bad" or "dishonest" repair): after disablement of the vehicle, ~~the driver changes~~ the quality of the reagent **is changed**, but, soon after, ~~changes~~ it **is changed** again for a poor quality one. The **reagent** inducement system is immediately reactivated and vehicle operation is disabled after 2 engine operating hours;

(c) Repair case 2 ("good" repair): after disablement of the vehicle, ~~the driver rectifies~~ the quality of the reagent **is rectified**. However, some time afterwards, ~~he refills~~ it **is refilled** again with a poor quality reagent. The **reagent** warning, inducement, and counting processes restart from zero."

Annex 11, Appendix 2, paragraph A.2.5.4., amend to read:

"A.2.5.4. Figure 4 illustrates three cases of failure of the urea dosing system. This figure also illustrates the process that applies in the case of the monitoring failures described in paragraph 9. of this annex:

(a) Use case 1: ~~the driver continues operating~~ the vehicle **operated** in spite of the warning until vehicle operation is disabled;

(b) Repair case 1 ("good" repair): after disablement of the vehicle, the ~~driver repairs~~ the dosing system **is repaired**. However, some time afterwards, the dosing system fails again. The **reagent** warning, inducement, and counting processes restart from zero;

(c) Repair case 2 ("bad" repair): during the low-level **reagent** inducement time (torque reduction), the ~~driver repairs~~ the dosing system **is repaired**. Soon after, however, the dosing system fails again. The low-level **reagent** inducement system is immediately reactivated and the counter restarts from the value it had at the time of repair."

Annex 11, Appendix 4, amend to read:

"Demonstration of correct installation on a vehicle in the case of engines type-approved as a separate technical unit

…

The demonstration shall address the conformity of the following elements to the requirements of this annex:

(a) The installation on board the vehicle as regards its compatibility with the engine-system (hardware, software and communication);

(b) The **reagent** warning and **reagent** inducement systems (for example, pictograms, activation schemes, etc.);

(c) The reagent tank and the elements (for example, sensors) mounted on the vehicle for the purpose of complying with this annex.

Correct activation of the **reagent** warning and **reagent** inducement systems, and of the information storage and on-board and off-board communication systems, may be checked. No check of these systems shall require the dismounting of the engine system or components, nor shall it generate unnecessary testing burden by requiring processes such as changing of the urea quality or running of the vehicle or engine for long periods of time. In order to minimise the burden upon the vehicle manufacturer, electric disconnections and simulation of counters with high operating hours shall be selected as checks on these systems if possible."

Annex 11, Appendix 5 paragraph A.5.3.1., amend to read:

"A.5.3.1. The "NO x control information" shall contain at least the following information:

(a) The VIN (vehicle identification number);

(b) The status of the **reagent** warning system (active; non-active);

(c) The status of the low-level **reagent** inducement system (active; enabled; non-active);

(d) The status of the severe **reagent** inducement system (active; enabled; non-active);

…"

Annex 14, paragraph 4.3.1., amend to read:

"4.3.1. Dual-fuel operating mode indicator

Dual-fuel engines and vehicles shall provide ~~to the driver~~ a visual indication **to the driver or a signal to the ADS (as applicable)** of the mode under which the engine operates (dual-fuel mode, diesel mode, or service mode)."

Annex 14, paragraph 4.3.1.2., amend to read:

"4.3.1.2. The dual-fuel mode indicator shall be set for at least one minute on dual-fuel mode or diesel mode as soon as the engine operating mode is changed from diesel to dual-fuel mode or vice-versa. This indication is also required for at least one minute at key-on, or at the request of the manufacturer at engine cranking. The indication shall also be given upon ~~the driver's~~**a** request **by the driver or the ADS (as applicable)**."

Annex 14, paragraph 4.3.2., amend to read:

"4.3.2. A dual-fuel vehicle shall be equipped with a dual-fuel warning system that alerts the driver **or the ADS (as applicable)** that the gaseous fuel tank will soon become empty.

…"

Annex 14, paragraph 4.3.2.1., amend to read:

"4.3.2.1. Characteristics of the dual-fuel warning system

The dual-fuel warning system shall consist of a visual alert system **to the driver** (icon, pictogram, etc.) left to the choice of the manufacturer**, or a signal to the ADS (if applicable)**. It may include, at the choice of the manufacturer, an audible component. In that case, the cancelling of that component by the driver is permitted.

..."

II. Justification

1. The document introduces changes required to incorporate vehicles with Automated Driving Systems into the existing Regulation.

2. References to the Consolidated Resolution on the Construction of Vehicles (R.E.3.) are updated to include ADS equipped vehicles in the scope. Vehicle categories X and Y are introduced in Revision 8 of R.E.3, prepared by the Task Force on Automated Vehicle Categorisation (TF-AVC) under GRSG and GRVA, and are not capable to be driven manually above 6 km/h.

3. Driver related definitions might not be applicable in the case of vehicles equipped with an ADS, therefore paragraph 2.35. (Malfunction Indication) was amended to include ADS. Furthermore, vehicles of categories X and Y do not have a driver, therefore the mass of the driver should not be included in paragraphs 2.55. (reference mass) and 2.62. (unladen mass).

4. "Driver warning" and "driver inducement" systems were renamed to "reagent warning" and "reagent inducement" systems respectively, to account for vehicles without a human driver.

5. Special provisions regarding testing are included for vehicles equipped with an ADS in new paragraph 1.2. to Annex 8.

6. Reference to new amendment of Special Resolution No. 1 was made to include vehicle equipped with an ADS.

7. The connector location in Annex 9B, paragraph 4.7.3.3., was amended to make it applicable to vehicles of categories X and Y.

8. Driver messages and warnings are changed to make the requirements suitable for vehicles with and without a human driver (sending signal to the ADS).