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

Proposal for Supplement 1 to the 01 Series of amendments to UN Regulation No. 132 (Retrofit Emission Control Devices (REC))

Submitted by the expert from the European Commission*

The text reproduced below was prepared by the expert from the European Commission, Directorate-General Joint Research Centre, to bring the requirements of UN Regulation No. 132 up to the state of the 05 series of amendments to UN Regulation No. 96. A first draft of this proposal (GRPE-76-13) was introduced at the seventy-sixth session of the Working Party on Pollution and Energy (GRPE) (see report ECE/TRANS/WP.29/GRPE/76, para. 26). The text is reproduced as a consolidated version.

* In accordance with the programme of work of the Inland Transport Committee for 2018–2019 (ECE/TRANS/274, para. 123 and ECE/TRANS/2018/21 and Add.1, Cluster 3), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

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I. Proposal

Paragraph 3.13., amend to read*:*

"3.13. "*Engine system*" means

(a) For vehicles defined in paragraph 2.1., the engine, the emission control system and the communication interface (hardware and messages) between the engine system Electronic Control Unit(s) (ECU) and any other powertrain or vehicle control unit.

(b) For engines defined in paragraphs 2.2. to 2.4., an energy converter, other than a gas turbine, designed to transform chemical energy (input) into mechanical energy (output) with an internal combustion process; it includes, where they have been installed, the emission control system and the communication interface (hardware and messages) between the engine's electronic control unit(s) and any other powertrain or category T vehicle or non-road mobile machinery control unit."

Paragraph 3.31., amend to read*:*

"3.31. *"Particle number*" means the number of particles which is defined in the relevant series of amendments to UN Regulation**s** Nos. 49 **and 96**."

Paragraph 5.4., amend to read*:*

"5.4. REC samples for approval testing shall be clearly identified with at least the applicant's name and the reference of the application **for type approval**."

Paragraph 7.5.1., amend to read*:*

"7.5.1. A particulate reduction REC shall be equipped with a monitoring device that detects incorrect operation or removal of the REC and that triggers an audible and/or visual alarm to the operator. For reagent based particulate reduction REC the monitoring device **shall include the detection of the interruption of** ~~may interrupt~~ the input of any reagent or additive~~, if necessary~~. The warning system can be based for example on the continuous measurement of the engine exhaust back-pressure"

Paragraph 7.9., amend to read*:*

"7.9. The approval shall be conditional upon the **manufacturer providing** ~~the following sub-paragraphs.~~**:**

~~7.9.1.~~**(a)** ~~The manufacturer providing~~ written maintenance instructions to be given by the installer to the driver or operator.

~~7.9.2.~~**(b)** ~~The manufacturer providing~~ installation documents for the REC.

~~7.9.3.~~**(c)** ~~The manufacturer providing~~ instructions for an the operator warning system, ~~an~~ **the** inducement system and the reagent freeze protection (where applicable) to be given by the installer to the **repair**-workshop, or the driver or the operator, as appropriate.

~~7.9.4.~~**(d)** ~~The manufacturer providing a~~ written statement to the installer, to be given to the driver or operator, on the normal operating conditions (temperature range, environmental conditions, …) within which the REC will operate correctly."

Paragraph 8.2.2. is inserted*:*

"**8.2.2.** **The specific requirements regarding the approval of a REC with respect to the emissions limits set out in the 06 series of amendments of UN Regulation No 49 or 05 series of amendments of UN Regulation No 96 are laid down respectively in Annex 12 and Annex 13.**"

Renumber *paragraph 8.2.2. (former)* as *paragraph 8.2.3. (new)*

Paragraph 8.3.2., amend to read*:*

"8.3.2. The reduction efficiency shall be determined by comparison of the emissions measured over the weighted WHTC for REC to be applied to heavy-duty engines or over the weighted NRTC for REC to be applied to non-road mobile machinery or **Category T vehicles** ~~agricultural and forestry tractor~~ engines. The reduction efficiency shall be calculated as defined in 8.3.4. of this Regulation."

Paragraph 8.5.2., amend to read*:*

"8.5.2. Direct sampling from raw exhaust gas prior to dilution is permitted. The dilution ratios of the particle number diluters (PND1 and PND2 of the particle transfer system, as defined in UN Regulation**s** Nos. 49 **and 96**) shall then be adapted to the measurement range of the Particle Number Counter (PNC)."

Paragraph 8.5.2., amend to read:

"8.6.2. For Class III and Class IV REC, emissions of ammonia shall not exceed a mean value of 25 ppm when measured using the procedures defined in Appendix 7 to Annex 4 of the 06 series of amendments to **UN** Regulation No. 49 **or in Appendix 7 to Annex 4 of the 05 series of amendment to UN Regulation No. 96.**"

Annexes 1, first paragraph of the Information document, amend to read:

"Information document No..…... of **UN** Regulation No. 132 relating to the type approval of Retrofit Emission Control devices (REC) for heavy duty vehicles, **Category T vehicles** ~~agricultural tractors~~ and non-road mobile machinery equipped with compression ignition engines."

Paragraph 14.1., subparagraph (d) and (e) and paragraphs 4.3.5., 4.3.6., 5.3.5. and 5.3.6. in Annex 1, amend units to read:

"**(g/m^3)**"

Annex 3, paragraph 1., amend to read:

"

Engine No.	*1*	*2*	*n*
Make			
Type			
Engine			
Power			
Category/**Sub-category**			

"

Annex 3, paragraph 3., amend to read:

"

Number			
Vehicle or engine manufacturer			
Model year from/to			
Engine type			
~~Capacity/cylinder~~ **Swept volume /cylinder** (cm^3)			
Swept volume ~~Capacity~~VH (cm^3)			
~~engine~~ **Engine** ~~net~~ power (kW ~~with~~ **@** min^{-1})**(1)**			
Engine baseline emissions			
Silencer replaced			
Type identification of the REC			
REC Type and Reduction Level			

(1) Either engine power according to UN Regulation No.85 or engine maximum net power according to UN Regulation No. 120 or engine rated net power according to UN Regulation No. 120 as applicable

"

Annex 5, paragraph 4.6.1., (second sub-paragraph), amend to read:

" The determination of the NO_2 and NO_x-mass emissions is to be ~~determined~~ **carried out** by simultaneous measurement in accordance with paragraph 4.7.2. of this annex and paragraph 13. of this Regulation. "

Annex 5, paragraph 4.7.2., (third sub-paragraph), amend to read:

" For CI engines used in non-road mobile machinery or Category T vehicles having an installed net power higher than ~~18~~ **19** kW, but not more than 560 kW the calculation of the NO_x and NO_2 emissions shall be determined over the complete NRTC cycle."

Annex 6, paragraph 4.3., (fourth sub-paragraph), amend to read:

" For CI engines used in non-road mobile machinery or Category T vehicles having an installed net power higher than ~~18~~ **19** kW, but not more than 560 kW the calculation of the NO_x and NO_2 emissions shall be determined over the complete NRTC cycle."

Table A9/2 of Annex 9, amend to read:

Equivalence Matrix for UN Regulation No. 96 / REC Class I / II

Baseline[*]	*Net Power [kW]*	*Component [g/kWh]*	*Class I / II, to the standard of*										
			H	*I*	*J*	*K*	*L*	*M*	*N*	*P*	*Q*	*R*	***Stage V***
E	130 ≤ P ≤ 560	PM	-	-	-	-	0.025	-	-	-	0.025	-	**0.015**
F	75 ≤ P < 130	PM	-	-	-	-	-	0.025	-	-	-	0.025	**0.015**
G	37 ≤ P < 75	PM	-	-	-	-	-	-	0.025 (1)	0.025(2)	-	0.025 (1)	**0.015**
D**(3)**	19 ≤ P < 37	PM	-	-	-	0.6	-	-	-	-	-	-	**0.015**
H	130 ≤ P ≤ 560	PM	-	-	-	-	0.025	-	-	-	0.025	-	**0.015**
I	75 ≤ P < 130	PM	-	-	-	-	-	0.025	-	-	-	0.025	**0.015**
J	37 ≤ P < 75	PM	-	-	-	-	-	-	0.025 (1)	0.025(2)-	-	0.025 (1)	**0.015**
K	19 ≤ P < 37	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
L	130 ≤ P ≤ 560	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
M	75 ≤ P < 130	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
N	56 ≤ P < 75	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
P	37 ≤ P < 56	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
Q	130 ≤ P ≤ 560	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
R	56 ≤ P < 130	PM	-	-	-	-	-	-	-	-	-	-	**0.015**

(1) Only for engines 56 ≤ P < 75

(2) Only for engines 37 ≤ P < 56

(3) Power band 19 ≤ P < 37 adapted to the subdivision defined in 05 series of amendment of UN Regulation No. 96 (Stage V)

[*] Where the baseline corresponds to that in 04 series of amendment of UN Regulation No. 96.

Table A9/3 of Annex 9, amend to read:

Equivalence Matrix for UN Regulation No. 96 / REC Class III

*Base-line**	*Net Power*	*Component*	*Class III, to the standard of*										
	[kW]	*[g/kWh]*	*H*	*I*	*J*	*K*	*L*	*M*	*N*	*P*	*Q*	*R*	***Stage V***
E	130 ≤ P ≤ 560	NO_x	4.0 (4)	-	-	-	2.0	-	-	-	0.4	-	-
F	75 ≤ P < 130	NO_x	-	4.0 (4)	-	-	-	3.3	-	-	-	0.4	-
G	37 ≤ P < 75	NO_x	-	-	4.7 (4)	-	-	-	3.3 (1)	4.7 (2,4)	-	0.4 (1)	-
D**(3)**	19 ≤ P < 37	NO_x	-	-	-	7.5 (4)	-	-	-	-	-	-	**4.70 (4)**
H	130 ≤ P ≤ 560	NO_x	-	-	-	-	2.0	-	-	-	0.4	-	-
I	75 ≤ P < 130	NO_x	-	-	-	-	-	3.3	-	-	-	0.4	-
J	37 ≤ P < 75	NO_x	-	-	-	-	-	-	3.3 (1)	4.7(2,4)	-	0.4 (1)	-
K	19 ≤ P < 37	NO_x	-	-	-	-	-	-	-	-	-	-	-
L	130 ≤ P ≤ 560	NO_x	-	-	-	-	-	-	-	-	0.4	-	-
M	75 ≤ P < 130	NO_x	-	-	-	-	-	-	-	-	-	0.4	-
N	56 ≤ P < 75	NO_x	-	-	-	-	-	-	-	-	-	0.4	-
P	37 ≤ P < 56	NO_x	-	-	-	-	-	-	-	-	-	-	**4.70 (4)**
Q	130 ≤ P ≤ 560	NO_x	-	-	-	-	-	-	-	-	-	-	-
R	56 ≤ P < 130	NO_x	-	-	-	-	-	-	-	-	-	-	-

(1) Only for engines 56 ≤ P < 75
(2) Only for engines 37 ≤ P < 56
(3) Power band 19 ≤ P < 37 adapted to the subdivision defined in 05 series of amendment of UN Regulation No. 96 (Stage V)
(4) Sum of hydrocarbons and oxides of nitrogen
* Where the baseline corresponds to that in 04 series of amendment of UN Regulation No. 96.

Table A9/4 of Annex 9, amend to read:

Equivalence Matrix for UN Regulation No. 96 / REC Class IV

*Baseline**	*Net Power [kW]*	*Component [g/kWh]*	*Class IV, to the standard of*										
			H	*I*	*J*	*K*	*L*	*M*	*N*	*P*	*Q*	*R*	***Stage V***
E	130 ≤ P ≤ 560	PM	-	-	-	-	0.025	-	-	-	0.025	-	**0.015**
		NO_x	4.0 (4)	-	-	-	2.0	-	-	-	0.4	-	**-**
F	75 ≤ P < 130	PM	-	-	-	-	-	0.025	-	-	-	0.025	**0.015**
		NO_x	-	4.0 (4)	-	-	-	3.3	-	-	-	0.4	**-**
G	37 ≤ P < 75	PM	-	-	-	-	-	-	0.025 (1)	0.025(2)	-	0.025 (1)	**0.015**
		NO_x	-	-	4.7 (4)	-	-	-	3.3 (1)	4.7(2,4)	-	0.4 (1)	**-**
D**(3)**	19 ≤ P < 37	PM	-	-	-	0.6	-	-	-	-	-	-	**0.015**
		NO_x	-	-	-	7.5 (4)	-	-	-	-	-	-	**4.70 (4)**
H	130 ≤ P ≤ 560	PM	-	-	-	-	0.025	-	-	-	0.025	-	**0.015**
		NO_x	-	-	-	-	2.0	-	-	-	0.4	-	**-**
I	75 ≤ P < 130	PM	-	-	-	-	-	0.025	-	-	-	0.025	**0.015**
		NO_x	-	-	-	-	-	3.3	-	-	-	0.4	**-**
J	37 ≤ P < 75	PM	-	-	-	-	-	-	0.025 (1)	0.025(2)	-	0.025 (1)	**0.015**
		NO_x	-	-	-	-	-	-	3.3 (1)	4.7 (2,4)	-	0.4 (1)	**-**
K	19 ≤ P < 37	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
		NO_x	-	-	-	-	-	-	-	-	-	-	**4.70 (4)**
L	130 ≤ P ≤ 560	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
		NO_x	-	-	-	-	-	-	-	-	0.4	-	**-**
M	75 ≤ P < 130	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
		NO_x	-	-	-	-	-	-	-	-	-	0.4	**-**
N	56 ≤ P < 75	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
		NO_x	-	-	-	-	-	-	-	-	-	0.4	**-**
P	37 ≤ P < 56	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
		NO_x	-	-	-	-	-	-	-	-	-	-	**4.70 (4)**
Q	130 ≤ P ≤ 560	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
		NO_x	-	-	-	-	-	-	-	-	-	-	**-**
R	56 ≤ P < 130	PM	-	-	-	-	-	-	-	-	-	-	**0.015**
		NO_x	-	-	-	-	-	-	-	-	-	-	**-**

(1) Only for engines 56 ≤ P < 75

(2) Only for engines 37 ≤ P < 56

(3) Power band 19 ≤ P < 37 adapted to the subdivision defined in 05 series of amendment of UN Regulation No. 96 (Stage V)

(4) Sum of hydrocarbons and oxides of nitrogen

* Where the baseline corresponds to that in 04 series of amendments of UN Regulation No. 96.

Paragraph 8.2. of Annex 10, amend to read:

"8.2. **The manufacturer shall specify a minimum acceptable reagent concentration CDmin, which results in tailpipe NO_X emissions not exceeding the lower of either the applicable NO_X limit multiplied by 2.25 or the applicable NO_X limit plus 1.5 g/kWh. For engine sub-categories with a combined HC and NO_X limit, the applicable NO_X limit value for the purpose of this paragraph shall be the combined limit value for HC and NO_X reduced by 0.19 g/kWh.**

~~The manufacturer shall specify a minimum acceptable reagent concentration CDmin, which results in tailpipe NO_x emissions not exceeding~~

~~(a) 0.9 g/kWh for retrofitted engine systems complying with the NO_x emission limit for stage Q and R of Regulation No. 96; or~~

~~(b) The NO_x emission limit + 1.5 g/kWh for all other systems.~~

"

Insert new Annex 13, to read:

"Annex 13

Specific requirements regarding the approval of a REC with respect to the emission limits set out in the 05 series of amendments of UN Regulation No. 96

1. Introduction

This annex sets out the specific requirements for the approval of a REC fitted to an engine, for the purpose of meeting the emission limits set out in the 05 series of amendments to UN Regulation No. 96.

2. Specific requirements

2.1. The retrofitted engine system shall meet the following specific requirements

2.1.1. The NO_x and PM emissions limits set out in Table 7 and Table 8, Appendix 1 to paragraph 5. of the 05 series of amendments to UN Regulation No. 96.

2.1.2. The requirements for the verification of the durability of engine systems, as laid down in Annex 8 to the 05 series of amendments to UN Regulation No. 96.

2.1.3. The specific requirements to limit off-cycle emissions, as laid down in paragraph 5.6. of the 05 series of amendments to UN Regulation No. 96.

2.1.4. The requirement to verify the emissions of crankcase gases, as laid down in paragraph 5.7. of the 05 series of amendments to UN Regulation No. 96.

2.1.5. The requirements with regard to emission control strategies NO_x control measures and particulate control measures, as laid down in Annex 9 to the 05 series of amendments to UN Regulation No. 96.

2.1.6. Notwithstanding paragraph 8.6.2. of this Regulation, for Class III and Class IV REC, emissions of ammonia shall not exceed a mean value of 10 ppm when measured according to the requirements of paragraph 3.4. of Annex 9 to the 05 series of amendments to UN Regulation No. 96."