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AMENDMENTS TO THE PROPOSAL FOR SUPPLEMENT 2 TO THE 04 SERIES OF AMENDMENTS TO REGULATION No. 49

(Emissions of C.I., NG, and P.I. (LPG) engines)

Submitted by the Secretary of the GRPE informal working group on WHDC

Note: The text reproduced below was prepared by the Secretary of the GRPE informal working group on WHDC. It is aimed at inserting mainly editorial corrections to the initial text adopted by GRPE at its fifty-second session. The modifications to ECE/TRANS/WP.29/2006/124 are marked in **bold** characters. This document is submitted to WP.29 and AC.3 for consideration and vote.

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http://www.unece.org/trans/main/welcwp29.htm

Page 2, Annex 10, paragraph 3.1.2.

For the existing text substitute

3.1.2. "delay time" means the **difference in** time between the change of the component to be measured at the reference point and a system response of 10 per cent of the final reading (t_{10}) **with the sampling probe being defined as the reference point**. For the gaseous components, this is the transport time of the measured component from the sampling probe to the detector.

Page 3, Annex 10, paragraph 3.1.9.

For the existing text substitute

3.1.9. "full flow dilution method" means the process of mixing **the total exhaust flow with dilution air** prior to separating a fraction of the diluted exhaust stream for analysis.

Page 3, Annex 10, paragraph 3.1.16.

For will be read **are**

Page 3, Annex 10, paragraph 3.1.18.

Delete of the raw exhaust

Page 4, Annex 10, paragraph 3.1.22.

For speed, torque, and stability criteria read **speed and torque** criteria

Page 4, Annex 10, paragraph 3.1.24.

For the existing text substitute

3.1.24. "response time" means the difference in time between **the** change of the component to be measured at the reference point **and a system response of 90 per cent of the final reading (t_{90}) with the sampling probe being defined as the reference point,** whereby the change of the measured component is at least 60 per cent full scale (FS) and takes place in less than 0.1 second. The system response time **consists of the delay time to the system and of the rise time of the system**.

Page 4, Annex 10, paragraphs 3.1.25. and 3.1.28.

For means the time read means the **difference in** time

Page 8, Annex 10, paragraph 3.3.

Delete β molar carbon ratio (C/C)
For $C_{\beta}H_{\alpha}O_{\varepsilon}N_{\delta}S_{\gamma}$ read $\mathbf{C}H_{\alpha}O_{\varepsilon}N_{\delta}S_{\gamma}$

Page 9, Annex 10, paragraph 5.1.

The existing text should read

5.1. Emission of gaseous and particulate pollutants

The emissions of gaseous and particulate pollutants by the engine shall be determined on the WHTC and WHSC test cycles, as described in paragraph 7. The measurement systems shall meet the linearity requirements **in paragraph 9.2. and the specifications in paragraph 9.3. (gaseous emissions measurement), paragraph 9.4. (particulate measurement) and in Appendix 3 to this annex.**

Other systems or analyzers ……

Page 16, Annex 10, paragraph 6.6.

Delete to the inlet of the beginning
For after-treatment device read after-treatment **system**

Page 18, Annex 10, paragraph 6.8.

For in the market read **on** the market

Page 22, Annex 10, paragraph 7.4.

The last box in the chart substitute

Test cycle validation	**paragraph 7.7.**
Data collection and evaluation	paragraph 7.8.4.
Emissions calculation	paragraph 8.

Page 23, Annex 10, paragraph 7.5.

For speed vs. torque curve read speed vs. torque **and speed vs. power curves**

Page 27, Annex 10, paragraph 7.7.2.

For the criteria of table 2 must be met read the criteria of table 2 **shall** be met

Page 28, Annex 10, paragraph 7.8.1.

For hydrocarbons and oxides read hydrocarbons**, methane** and oxides

Page 29, Annex 10, paragraph 7.8.2.1.

For a forced after-treatment cool down read a forced after-treatment **system** cool down

Page 29, Annex 10, paragraph 7.8.2.2.

For the sampling filters read the **particulate** sampling **filter**
For each filter read (twice) **the** filter

Page 30, Annex 10, paragraph 7.8.4.

For the existing text substitute

7.8.4. Cycle run

The general requirements laid down in this paragraph apply to both, the cold start test referred to in paragraph 7.8.3.1. and to the hot start test referred to in paragraph 7.8.3.3.

Page 31, Annex 10, paragraph 7.8.4.2.

For concentrations (HC, CO and NO_x) read concentrations ((**NM**)HC, CO and NO_x)
For CO, CO_2, and NMHC shall be read CO, CO_2, and NMHC **may** be

Page 32, Annex 10, paragraph 7.8.4.5.

The existing text of the last subparagraph should read

The particulate **filter** shall be returned to the weighing chamber no later than one hour after completion of the test. **It** shall be conditioned in a petri dish, which is protected against dust contamination and allows air exchange, for at least one hour, and then weighed. The gross weight of the **filter** shall be recorded.

Page 33, Annex 10, paragraph 8.1.

The existing text should read

8.1. Dry/wet correction

If the emissions **are measured on a dry** basis, the measured concentration shall be converted to a wet basis according to the following equation:

$$c_w = k_w \times c_d \qquad (7)$$

where:
$\boldsymbol{c_w}$ is the wet concentration in ……
……

Page 36, Annex 10, paragraph 8.3.1.2.

The existing text should read

8.3.1.2. Response time

For the purpose of emissions calculation, the response time of either method described in paragraphs 8.3.1.3 to 8.3.1.6 shall be equal to or less than **the analyzer response time of $\leq$ 10 s, as required in paragraph 9.3.5.**

For the purpose of controlling of ……

Page 38, Annex 10, paragraph 8.3.1.5.

The existing text should read

8.3.1.5. Tracer measurement method

……

The calculation of the exhaust gas flow shall be as follows:

$$q_{m\mathrm{ew,i}} = \frac{q_{v\mathrm{t}} \times \rho_\mathrm{e}}{60 \times \left(c_\mathrm{mix,i} - c_\mathrm{b}\right)} \qquad (21)$$

where:
$q_{m\mathrm{ew,i}}$ is the instantaneous exhaust mass flow rate, kg/s
$q_{v\mathrm{t}}$ is tracer gas flow rate, cm^3/min
$\boldsymbol{c_{mix,i}}$ is the instantaneous concentration ……

……

Page 38, Annex 10, paragraph 8.3.1.6.

The existing text should read

8.3.1.6. Airflow and air to fuel ratio measurement method

……

with

$$A/F_{\text{st}} = \frac{138.0 \times \left(1 + \frac{\alpha}{4} - \frac{\varepsilon}{2} + \gamma\right)}{12.011 + 1.00794 \times \alpha + 15.9994 \times \varepsilon + 14.0067 \times \delta + 32.065 \times \gamma} \quad (23)$$

$$\lambda_{\text{i}} = \frac{\left(100 - \frac{c_{\text{COd}} \times 10^{-4}}{2} - c_{\text{HCw}} \times 10^{-4}\right) + \left(\frac{\alpha}{4} \times \frac{1 - \frac{2 \times c_{\text{COd}} \times 10^{-4}}{3.5 \times c_{\text{CO2d}}}}{1 + \frac{c_{\text{CO}} \times 10^{-4}}{3.5 \times c_{\text{CO2d}}}} - \frac{\varepsilon}{2} - \frac{\delta}{2}\right) \times \left(c_{\text{CO2d}} + c_{\text{COd}} \times 10^{-4}\right)}{4.764 \times \left(1 + \frac{\alpha}{4} - \frac{\varepsilon}{2} + \gamma\right) \times \left(c_{\text{CO2d}} + c_{\text{COd}} \times 10^{-4} + c_{\text{HCw}} \times 10^{-4}\right)} \quad (24)$$

where:

……

<u>Page 39, Annex 10, paragraph 8.3.2.1.</u>

<u>For</u> deviate from Annex 2 <u>read</u> deviate from **the specifications in** Appendix 2

<u>Page 41, Annex 10, paragraph 8.3.2.4., table 4, note b)</u>

<u>For</u> wet air <u>read</u> **dry** air

<u>Pages 42 and 43, Annex 10, paragraph 8.3.2.5.</u>

The existing text <u>should read</u>

8.3.2.5. Calculation of mass emission based on exact equations

……

The molar mass of the exhaust, M_{e}, shall be derived for a general fuel composition $\mathbf{CH_{\alpha}O_{\varepsilon}N_{\delta}S_{\gamma}}$ under the assumption of complete combustion, as follows:

$$M_{\text{e,i}} = \frac{1 + \frac{q_{m\text{f,i}}}{q_{m\text{aw,i}}}}{\frac{q_{m\text{f,i}}}{q_{m\text{aw,i}}} \times \frac{\frac{\alpha}{4} + \frac{\varepsilon}{2} + \frac{\delta}{2}}{12.011 + 1.00794 \times \alpha + 15.9994 \times \varepsilon + 14.0067 \times \delta + 32.065 \times \gamma} + \frac{\frac{H_{\text{a}} \times 10^{-3}}{2 \times 1.00794 + 15.9994} + \frac{1}{M_{\text{a}}}}{1 + H_{\text{a}} \times 10^{-3}}} \quad (30)$$

where:

……

Pages 43 and 44, Annex 10, paragraph 8.3.3.1.

For dilution air shall be higher than 288 K read dilution air shall **be $\geq$ 288 K**
For particulate sampling filters read **a** particulate sampling **filter**

Page 44, Annex 10, paragraph 8.3.3.2.

For total exhaust mass flow shall read total exhaust mass flow **of the manifold** shall

Pages 44 and 45, Annex 10, paragraph 8.3.3.3.

The existing text should read

8.3.3.3. System response time

For the control of a partial flow dilution system, a fast system response is required. The transformation time for the system shall be determined by the procedure in paragraph **9.4.7.3.** If the combined transformation time of the exhaust flow measurement (see paragraph 8.3.1.2.) and the partial flow system **is $\leq$ 0.3 s**, online control **shall** be used. If the transformation time exceeds 0.3 s, look ahead control based on a pre-recorded test run shall be used. In this case, the **combined** rise time shall be $\leq$ 1 s and the **combined delay time $\leq$ 10 s**.

The total system response shall be ……
……
(c) q_{mp} intercept of the regression line shall not exceed ± 2 per cent of q_{mp} maximum.

Look-ahead control is required if the combined transformation times of the particulate system, $t_{50,P}$ and of the exhaust mass flow signal, $t_{50,F}$ are > 0.3 s. In this case, a pre-test shall be run, and the exhaust mass flow signal of the pre-test be used for controlling the sample flow into the particulate system. A correct control of the partial dilution system is obtained, if the time trace of $q_{mew,pre}$ of the pre-test, which controls q_{mp}, is shifted by a "look-ahead" time of $t_{50,P} + t_{50,F}$.

For establishing the correlation between …… were determined in paragraph **9.4.7.3.**

Page 45, Annex 10, paragraph 8.3.3.4.

For filters read **filter**

Page 47, Annex 10, paragraph 8.4.1.1.

The existing text should read

8.4.1.1. Introduction

…… measurement device (V_0 for PDP, K_V for CFV, $\boldsymbol{C_d}$ **for** SSV) by either of the methods described in paragraphs 8.4.1.2. to **8.4.1.4**. If the total sample **flow of particulates (**$\boldsymbol{m_{sep}}$**) exceeds** 0.5 per cent of the total CVS flow (m_{ed}), the CVS flow shall …...

Page 50, Annex 10, paragraph 8.4.2.2.

For pollutants read (twice) **emissions**

Page 50, Annex 10, paragraph 8.4.2.3.

For the existing text substitute

8.4.2.3. Data evaluation

For continuous sampling, the emission concentrations (HC, CO and $\boldsymbol{NO_x}$**) shall be recorded and stored with at least 1 Hz on a computer system, for bag sampling one mean value per test is required. The diluted exhaust gas mass flow rate and all other data shall be recorded with a sample rate of at least 1 Hz.** For analogue analyzers the response will be recorded, and the calibration data may be applied online or offline during the data evaluation.

Page 51, Annex 10, paragraph 8.4.2.4.1.

Delete $q_{m\mathrm{dew}}$ is the diluted exhaust gas mass flow rate, kg/s
In table 5, note b), for wet air read **dry** air

Page 53, Annex 10, paragraph 8.4.3.1.

The existing text should read

8.4.3.1. Introduction

The determination of the particulates requires **double** dilution of the sample …… The temperature of the dilution air shall **be ≥ 288 K** (15 °C) in close proximity to the entrance into the dilution tunnel.

To determine the mass of the particulates, a particulate sampling system, **a** particulate sampling **filter**, a microgram balance, and …...

Page 55, Annex 10, paragraph 8.5.2.1.

The existing text should read

8.5.2.1. **Test result**

For the WHSC, hot WHTC, or cold WHTC, the following formula shall be applied:

$$e = \frac{m}{W_{act}} \tag{56}$$

where:
m is the mass emission of the component, g/test
W_{act} is the actual cycle work as determined according to paragraph 7.7.1., kWh

For the WHTC, the final test result shall be a weighted average from ……

Page 63, Annex 10, paragraph 9.3.4.

For all flowmeters shall read zero read all flowmeters **will read approximately zero in the absence of a leak**

Pages 63 and 64, Annex 10, paragraph 9.3.5.

The existing text should read

9.3.5. Response time check of the analytical system

……

The system response time shall be ≤ 10 s with a rise time of ≤ 2.5 s in accordance with paragraph 9.3.1.7. for all limited components (CO, NO_x, HC or NMHC) and all ranges used. **When using a NMC for the measurement of NMHC, the system response time may exceed 10 s.**

Page 67, Annex 10, paragraph 9.3.7.3.

For be determined read be **performed**
For A range read A **measuring** range

Page 71, Annex 10, paragraph 9.3.9.2.4.

For flow of the dehumidifier read flow **from** the dehumidifier

Page 71, Annex 10, paragraph 9.4.1.

For particulate sampling filters read **a** particulate sampling **filter**

Page 72, Annex 10, paragraph 9.4.3.2.

For filter weightings read filter **weighings**

Page 72, Annex 10, paragraph 9.4.3.4.

For filters read **filter**

Page 72, Annex 10, paragraph 9.4.3.5.

For filters read **filter**"
For their buoyancy read **its** buoyancy

Page 73, Annex 10, paragraph 9.4.4.

The title, for Specifications for flow measurement read Specifications for **differential** flow measurement **(partial flow dilution only)**

Pages 74 and 75, Annex 10, paragraphs 9.4.6. to 9.4.6.2.2.

The existing text should read

9.4.6. Calibration of the **flow measurement instrumentation**

9.4.6.1. **General specifications**

Each flowmeter used in a particulate sampling and partial flow dilution system shall be subjected to the linearity verification, as described in paragraph 9.2.1., as often as necessary to fulfil the accuracy requirements of this gtr. For the flow reference values, an accurate flowmeter traceable to international and/or national standards shall be used.

9.4.6.2. Calibration of differential flow measurement (partial flow dilution only)

The flowmeter or the flow measurement instrumentation shall be calibrated in one of the following procedures, such that the probe flow $q_{m\mathrm{p}}$ into the tunnel shall fulfil the accuracy requirements of paragraph 9.4.4.:

(a) ……

……

(d) A tracer gas, shall be fed into the exhaust ……. The accuracy of the sample flow shall be determined from the dilution **ratio** r_d:

$$q_{m\mathrm{p}} = q_{m\mathrm{dew}} / r_\mathrm{d} \quad (74)$$

The accuracies of the gas analyzers shall be taken into account to guarantee the accuracy of $q_{m\mathrm{p}}$.

9.4.7. Special requirements for the partial flow dilution system

9.4.7.1. Carbon flow check

A carbon flow check using ……

Page 75, Annex 10, paragraph 9.4.6.2.3.

Renumber the paragraph as **9.4.7.2.**
For paragraph 9.4.6.2.1. read (twice) paragraph **9.4.6.2.**

Page 75, Annex 10, paragraph 9.4.6.3.

Renumber the paragraph as **9.4.7.3**.

Page 95, Annex 10 - Appendix 3, paragraph A.3.1.1.

The existing text should read

A.3.1.1. Introduction

This annex contains **the basic requirements and the** general descriptions of **the sampling** and analyzing systems. Since various configurations can produce equivalent results, exact conformance with figures 9 and 10 is not required. **However, conformance with the basic requirements such as sampling line dimensions, heating and design is mandatory.** Components such as instruments, valves, solenoids, pumps, flow devices and switches may be used to ……

Pages 99 and 100, Annex 10 - Appendix 3, paragraph A.3.2.1.

The existing text should read

A.3.2.1. Introduction

This annex contains **the basic requirements and the** general descriptions of **the dilution** and particulate sampling systems. Since various configurations can produce equivalent results, exact conformance with figures 12 to 17 is not required. **However, conformance with the basic requirements such as sampling line dimensions, heating and design is mandatory.** Additional components such as instruments, valves, solenoids, pumps, and switches may be used to ……

Page 106, Annex 10 - Appendix 3, paragraph A.3.2.5.

The existing text should read

A.3.2.5. Components of figure 15

……

If the temperature at the inlet to the PDP, CFV or SSV is not kept within the limits stated above, a flow compensation system is required for continuous measurement of the flow rate and control of the proportional sampling into the double dilution system. For that purpose, the continuously measured flow rate signals are **used to maintain the proportionality of** the sample flow rate through the particulate filters of the double dilution system (see figure 17) **within ± 2.5 per cent**.

……

The engine exhaust shall be directed downstream at the point where it is introduced into the dilution tunnel, and thoroughly mixed. A mixing orifice may be used.

For the double dilution system, a sample from the dilution tunnel is transferred to the secondary dilution tunnel ………… immediately before the particulate filter.

DAF Dilution air filter

The dilution air (ambient air, synthetic air, or nitrogen) shall be filtered with a high-efficiency (HEPA) filter that has an initial minimum collection efficiency of 99.97 per cent. The dilution air shall have a temperature **of ≥ 288 K** (15 °C), and may be dehumidified.

…….

<u>Page 113, Annex 10 - Appendix 5, paragraph A.5.2.</u>

For the existing text <u>substitute</u>

A.5.2. Carbon flow rate into the engine (location 1)

The carbon mass flow rate into the engine for a fuel $\mathbf{CH_{\alpha}O_{\varepsilon}}$ is given by:

$$q_{mCf} = \frac{12.011}{12.011 + \alpha + 15.9994 \times \varepsilon} \times q_{mf} \qquad (86)$$

where:
q_{mf} is the fuel mass flow rate, kg/s

- - - - -