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PROGRESS IN THE DEVELOPMENT OF NEW GLOBAL TECHNICAL REGULATIONS OR AMENDMENTS TO ESTABLISHED GLOBAL TECHNICAL REGULATIONS

Gtr No. 4
(Worldwide harmonized Heavy Duty Certification (WHDC))

# Proposal for Amendment 2 to global technical regulation No. 4

Submitted by the secretary of the informal group WHDC */

This document was prepared to correct editorial errors in ECE/TRANS/WP.29/2009/121. The modifications to the text are marked in bold characters or strikethrough. In addition, the amendments to paragraph 7.6.3 (hot soak period) and to paragraph 8.6.3 (calculation of specific emissions) reflect the proposal of the United States of America in document ECE/TRANS/WP.29/2010/49 for solving the options on hot soak period and cold start weighting factor in this global technical regulation. The Executive Committee (AC.3) of the 1998 Agreement agreed to prepare the corresponding documents to be submitted to a vote at the June 2010 session of AC.3, after consideration by the Working Party on Pollution and Energy (GRPE) at its January 2010 session and by AC.3 at its March 2010 session (ECE/TRANS/WP.29/1079, para. 94).

*/ In accordance with the programme of work of the Inland Transport Committee for 2006-2010 (ECE/TRANS/166/Add.1, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance performance of vehicles. The present document is submitted in conformity with that mandate.

Paragraph 3.2., insert new symbols and correct the following symbols, to read:

| "Symbol | Unit | Term |
|---|---|---|
| $\boldsymbol{a_1}$ | - | **Slope of the regression** |
| $\boldsymbol{a_0}$ | - | **y intercept of the regression** |
| $\boldsymbol{c_{gas}}$ | **ppm/Vol per cent** | **Concentration on the gaseous components** |
| $\boldsymbol{e_r}$ ~~$e_p$~~ | g/kWh | Specific emission during regeneration |
| ~~$k_r$~~ | - | ~~Regeneration factor~~ |
| $\boldsymbol{k_{r,u}}$ | - | **Upward regeneration adjustment factor** |
| $\boldsymbol{k_{r,d}}$ | - | **Downward regeneration adjustment factor** |
| $\boldsymbol{m_b}$ ~~$m_{f,d}$~~ | mg | Particulate sample mass of the dilution air collected |
| $m_f$ | mg | **Particulate sampling filter mass** |
| $\boldsymbol{m_p}$ ~~$m_f$~~ | mg | Particulate sample mass collected |
| $\boldsymbol{M_d}$ | **g/mol** | **Molar mass of the dilution air** |
| $\boldsymbol{M_f}$ | **Nm** | **Torque absorbed by auxiliaries/equipment to be fitted** |
| $\boldsymbol{M_r}$ | **Nm** | **Torque absorbed by auxiliaries/equipment to be removed** |
| $n_r$ | - | Number of measurements **with** ~~during~~ regeneration |
| $\boldsymbol{P_f}$ | **kW** | **Power absorbed by auxiliaries/equipment to be fitted** |
| $\boldsymbol{P_r}$ | **kW** | **Power absorbed by auxiliaries/equipment to be removed** |
| $\boldsymbol{r^2}$ | - | **Coefficient of determination** |
| $\boldsymbol{s}$ | | **Standard deviation**" |

Paragraph 6.3.5., amend to read:

"6.3.5. Engine cycle work

The calculation of reference and actual cycle work (see paragraphs 7.4.8. and 7.8.6.) shall be based upon engine power according to paragraph 6.3.1. In this case, $\boldsymbol{P_f}$ ~~$P_a$~~ and $\boldsymbol{P_r}$ ~~$P_b$~~ of equation 4 are zero, and $P$ equals $P_m$.

If auxiliaries/equipment are installed according to paragraphs 6.3.2. and/or 6.3.3., the power absorbed by them shall be used to correct each instantaneous cycle power value $P_{m,i}$, as follows:

$$P_i = P_{m,i} - P_{f,i} + P_{r,i} \qquad (4)$$

where:

$P_{m,i}$ is the measured engine power, kW

$\boldsymbol{P_{f,i}}$ is the power absorbed by auxiliaries/equipment to be fitted, kW

$\boldsymbol{P_{r,i}}$ is the power absorbed by auxiliaries/equipment to be removed, kW"

Paragraph 6.6.2., amend to read:

"6.6.2. Periodic regeneration

…

With reference to the specific emission calculations in paragraph 8.6.3., the regeneration adjustment factors shall be applied, as follows:

(e) for a test without regeneration, $k_{r,u}$ shall be multiplied with or be added to, respectively, the specific emission *e* in equations 69, ~~70a~~ or **70b**~~,~~,

(f) for a test with regeneration, $k_{r,d}$ shall be multiplied with or **be added to** ~~be subtracted from~~, respectively, the specific emission *e* in equations 69 ~~70a~~ or **70b**~~.~~.

At the request of the manufacturer …"

Paragraph 7.3., the flowchart, the last box, amend the line "Data collection and evaluation" to read:

"Data collection and evaluation paragraph 7**.6.6./**7.7.4."

Paragraph 7.4.7., amend to read:

"7.4.7. Denormalization of engine torque

… shall be denormalized, using the mapping curve determined according to paragraph 7.4.3., as follows:

$$M_{\mathrm{ref,i}} = \frac{M_{\mathrm{norm,i}}}{100} \times M_{\mathrm{max,i}} + M_{\mathrm{f,i}} - M_{\mathrm{r,i}} \qquad (10)$$

where:

$M_{\mathrm{norm,i}}$ is the normalized torque, per cent
$M_{\mathrm{max,i}}$ is the maximum torque from the mapping curve, Nm
$\boldsymbol{M_{f,i}}$ is the torque absorbed by auxiliaries/equipment to be fitted, Nm
$\boldsymbol{M_{r,i}}$ is the torque absorbed by auxiliaries/equipment to be removed, Nm

If auxiliaries/equipment are fitted in accordance with paragraph 6.3.1. and Annex 7, $\boldsymbol{M_f}$ ~~$M_a$~~ and $\boldsymbol{M_r}$ ~~$M_b$~~ are zero.

…"

Paragraph 7.6.3., amend to read:

"7.6.3. Hot soak period

Immediately upon completion of the cold start test, the engine shall be conditioned for the hot start test **using a 10 ± 1 minutes hot soak period**. ~~by using one of the following options:~~
~~(a) 5 ± 1 minutes hot soak period~~
~~(b) 20 ± 1 minutes hot soak period~~

~~The option shall be selected by the Contracting Parties.~~"

Paragraph 7.8.4., amend to read:

"7.8.4. Drift verification

…

The following provisions apply for analyzer drift:

(a) The pre-test zero and span and post-test zero and span responses may be directly **inserted into equation 66** ~~applied to the drift calculation provisions~~ of paragraph 8.6.1. without determining **the** drift;

(b) If the **drift** ~~difference~~ between the pre-test and post-test results is less than 1 per cent of full scale, the measured concentrations may be used uncorrected or may be corrected for drift according to paragraph 8.6.1.;

(c) If the **drift** difference between the pre-test and post-test results is equal to or greater than 1 per cent of full scale, the test shall be voided or the measured concentrations shall be corrected for drift according to paragraph 8.6.1."

Paragraph 7.8.7., amend to read:

"7.8.7. Validation statistics of the test cycle

Linear regressions of the actual values **($n_{act}$, $M_{act}$, $P_{act}$)** on the reference values **($n_{ref}$, $M_{ref}$, $P_{ref}$)** shall be performed ~~for speed, torque and power~~ for both the WHTC and the WHSC.

To minimize the biasing effect of the time lag between the actual and reference cycle values, the entire engine speed and torque actual signal sequence may be advanced or delayed in time with respect to the reference speed and torque sequence. If the actual signals are shifted, both speed and torque shall be shifted by the same amount in the same direction.

The method of least squares shall be used, with the best-fit equation having the form:

$y = a_1 x + a_0$ (11)

where:

| | |
|---|---|
| $y$ | **is the** actual value of speed ($min^{-1}$), torque (Nm), or power (kW) |
| $a_1$ | **is the** slope of the regression line |
| $x$ | **is the** reference value of speed ($min^{-1}$), torque (Nm), or power (kW) |
| $a_0$ | **is the** y intercept of the regression line |

The standard error …"

Paragraph 8.4.2.1., amend to read:

"8.4.2.1. Introduction

…

Two calculation procedures are described in paragraphs 8.4.2.3. and 8.4.2.4., which are equivalent for the reference **fuels** of Annex 2. The procedure …"

Paragraph 8.6.3., amend to read:

"8.6.3. Calculation of the specific emissions

The specific emissions $e_{gas}$ or $e_{PM}$ (g/kWh) shall be calculated for each individual component in the following ways depending on the type of test cycle.

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

$$e = \frac{m}{W_{act}} \quad (69)$$

where:

$m$ is the mass emission of the component, g/test

$W_{act}$ is the actual cycle work as determined according to paragraph 7.8.6., kWh

For the WHTC, the final test result shall be a weighted average from cold start test and hot start test **according to the following equation** ~~by using either of the following options~~:

$$e = \frac{(0.14 \times m_{cold}) + (0.86 \times m_{hot})}{(0.14 \times W_{act,cold}) + (0.86 \times W_{act,hot})} \quad (70)$$

~~$$e = \frac{(0.1 \times m_{cold}) + (0.9 \times m_{hot})}{(0.1 \times W_{act,cold}) + (0.9 \times W_{act,hot})}$$~~ ~~(70b)~~

~~The option shall be selected by the Contracting Parties.~~

**where:**

$m_{cold}$ **is the mass emission of the component on the cold start test, g/test**

$m_{hot}$ **is the mass emission of the component on the hot start test, g/test**

$W_{act,cold}$ **is the actual cycle work on the cold start test, kWh**

$W_{act,hot}$ **is the actual cycle work on the hot start test, kWh**

**If periodic regeneration in accordance with paragraph 6.6.2 applies, the regeneration adjustment factors $k_{r,u}$ or $k_{r,d}$ shall be multiplied with or be added to, respectively, the specific emissions result *e* as determined in equations 69 and 70.**"

Paragraphs 3.1.10., 3.1.20., 3.2., 7.5.6., 7.6.6., 7.7.4, 8.1.2., 8.1.3., 8.4.3.1., 8.4.3.2.2., 8.5.2.3.1., 8.5.2.3.2., 8.5.2.3.3., 8.5.3.1., 9.2. table 7, 9.3.11., 9.4.6.3., A.3.1.3., A.3.2.1., A.3.2.2., A.3.2.3., A.3.2.4., A.3.2.5., replace: ~~dilution air~~ by **diluent**.

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