Transmitted by the Secretary of the GRPE working group on WHDC

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## AMENDMENTS TO DOCUMENT ECE/TRANS/WP.29/GRPE/2009/10

After the 28th WHDC meeting, the WHDC group would like to submit the following issues to GRPE for consideration and decision.

## A. Option 2: Reference fuel

Since EPA does not agree to the fuel specifications in Annex 2, the following alternatives are being proposed.

Alternative 1:

6.9. Specification of the reference fuel

Annex 2 specifies the ranges of parameters of the diesel reference fuel that shall be met for testing. Within the specified ranges, Contracting Parties may require tighter specifications for engines to be type approved or certified in their territory. Since fuel characteristics influence the engine exhaust gas emission, the characteristics of the fuel used for the test shall be determined, recorded and declared with the results of the test.

### Annex 2

DIESEL REFERENCE FUEL

| Parameter | Unit | Limits 1/ | | Test method 5/ | |
|---|---|---|---|---|---|
| | | Minimum | Maximum | | |
| Cetene number | | **40** | **57** | ISO 5165 | |
| Density at 15 °C | kg/m$^3$ | 835 | **855** | ISO 3675 | |
| Distillation: | | | | | |
| - 50 per cent vol. | °C | **243** | 295 | ISO 3405 | |
| - final boiling point | °C | 321 | **370** | | |
| Flash point | °C | 55 | | ISO 2719 | |
| Kinematic viscosity at 40 °C | mm$^2$/s | 2.0 | 4.0 | ISO 3104 | |
| Polycylic aromatic hydrocarbons | per cent m/m | 2.0 | 6.0 | EN 12916 | |
| Water content | per cent m/m | | 0.02 | EN-ISO 12937 | |
| Sulphur content | mg/kg | | 15 | EN-ISO 14596 | |
| Total aromatics | per cent m/m | 10 | **35** | EN 12916 | |
| Lubricity (HFRR at 60 °C) | µm | | 400 | CEC F-06-A-96 | |
| Oxidation stability @ 110°C 2/3/ | h | 20 | | EN 14112 | |
| FAME 4/ | per cent v/v | | 5.5 | EN 14078 | |

Alternative 2 (leave option 2 in the gtr):

6.9. Specification of the reference fuel

The use of one standardized reference fuel has always been considered as an ideal condition for ensuring the reproducibility of regulatory emission testing, and Contracting Parties are encouraged to use such fuel in their compliance testing. However, until performance requirements (i.e. limit values) have been introduced into this gtr, Contracting Parties to the 1998 Agreement are allowed to define their own reference fuel for their national legislation, to address the actual situation of market fuel for vehicles in use.

The appropriate diesel reference fuels of the European Union, the United States of America and Japan listed in Annex 2 are recommended to be used for testing. Since fuel characteristics influence the engine exhaust gas emission, the characteristics of the fuel used for the test shall be determined, recorded and declared with the results of the test.

## B. Corrigendum to table 4

| Event | Conditions | Permitted point omissions |
|---|---|---|
| Minimum operator demand (idle point) | $n_{ref}$ = 0 per cent<br>and<br>$M_{ref}$ = 0 per cent<br>and<br>$M_{act} > (M_{ref} - 0.02\ M_{max.\ mapped\ torque})$<br>and<br>$M_{act} < (M_{ref} + 0.02\ M_{max.\ mapped\ torque})$ | speed and power |
| Minimum operator demand (motoring point) | $M_{ref}$ < 0 per cent | power and torque |
| Minimum operator demand | $n_{act} \leq 1.02\ n_{ref}$ and $M_{act} > M_{ref}$<br>**or**<br>$n_{act} > n_{ref}$ and $M_{act} \leq M_{ref}$<br>**or**<br>$n_{act} > 1.02\ n_{ref}$ and $M_{ref} < M_{act} \leq (M_{ref} + 0.02\ M_{max.\ mapped\ torque})$ | power and either torque or speed |
| Maximum operator demand | $n_{act} < n_{ref}$ and $M_{act} \geq M_{ref}$<br>**or**<br>$n_{act} \geq 0.98\ n_{ref}$ and $M_{act} < M_{ref}$<br>**or**<br>$n_{act} < 0.98\ n_{ref}$ and $M_{ref} > M_{act} \geq (M_{ref} - 0.02\ M_{max.\ mapped\ torque})$ | power and either torque or speed |

## C. Measurement of methane and non-methane hydrocarbons (proposal Poland)

| Fuel | $\rho_e$ | Gas | | | | | |
|---|---|---|---|---|---|---|---|
| | | $NO_x$ | CO | HC | $CO_2$ | $O_2$ | $CH_4$ |
| | | $\rho_{gas}$ [kg/m$^3$] | | | | | |
| | | 2.053 | 1.250 | a) | 1.9636 | 1.4277 | 0.716 |
| | | $u_{gas}$ b) | | | | | |
| Diesel | 1.2943 | 0.001586 | 0.000966 | 0.000479 | 0.001517 | 0.001103 | 0.000553 |
| Ethanol | 1.2757 | 0.001609 | 0.000980 | 0.000805 | 0.001539 | 0.001119 | 0.000561 |
| CNG c) | 1.2661 | 0.001621 | 0.000987 | **0.000528 d)** | 0.001551 | 0.001128 | 0.000565 |
| Propane | 1.2805 | 0.001603 | 0.000976 | 0.000512 | 0.001533 | 0.001115 | 0.000559 |
| Butane | 1.2832 | 0.001600 | 0.000974 | 0.000505 | 0.001530 | 0.001113 | 0.000558 |
| LPG e) | 1.2811 | 0.001602 | 0.000976 | 0.000510 | 0.001533 | 0.001115 | 0.000559 |

a) depending on fuel
b) at $\lambda$ = 2, dry air, 273 K, 101.3 kPa
c) *u* accurate within 0.2 % for mass composition of: C = 66 - 76 %; H = 22 - 25 %; N = 0 - 12 %
d) NMHC on the basis of $CH_{2.93}$ (for total HC the $u_{gas}$ coefficient of $CH_4$ shall be used)
e) *u* accurate within 0.2 % for mass composition of: C3 = 70 - 90 %; C4 = 10 - 30 %

Table 5:

Raw exhaust gas *u* values and component densities

| Fuel | $\rho_{de}$ | Gas |
|---|---|---|

| | | $NO_x$ | CO | HC | $CO_2$ | $O_2$ | $CH_4$ |
|---|---|---|---|---|---|---|---|
| | | $\rho_{gas}$ [kg/m³] | | | | | |
| | | 2.053 | 1.250 | a) | 1.9636 | 1.4277 | 0.716 |
| | | $u_{gas}$ b) | | | | | |
| Diesel | 1.293 | 0.001588 | 0.000967 | 0.000480 | 0.001519 | 0.001104 | 0.000553 |
| Ethanol | 1.293 | 0.001588 | 0.000967 | 0.000795 | 0.001519 | 0.001104 | 0.000553 |
| CNG c) | 1.293 | 0.001588 | 0.000967 | **0.000517 d)** | 0.001519 | 0.001104 | 0.000553 |
| Propane | 1.293 | 0.001588 | 0.000967 | 0.000507 | 0.001519 | 0.001104 | 0.000553 |
| Butane | 1.293 | 0.001588 | 0.000967 | 0.000501 | 0.001519 | 0.001104 | 0.000553 |
| LPG e) | 1.293 | 0.001588 | 0.000967 | 0.000505 | 0.001519 | 0.001104 | 0.000553 |

a) depending on fuel
b) at $\lambda = 2$, dry air, 273 K, 101.3 kPa
c) $u$ accurate within 0.2 % for mass composition of: C = 66 - 76 %; H = 22 - 25 %; N = 0 - 12 %
d) NMHC on the basis of $CH_{2.93}$ (for total HC the $u_{gas}$ coefficient of $CH_4$ shall be used)
e) $u$ accurate within 0.2 % for mass composition of: C3 = 70 - 90 %; C4 = 10 - 30 %

Table 6:

Diluted exhaust gas $u$ values and component densities

8.6.2. Calculation of NMHC and $CH_4$ ~~with the non-methane cutter~~

**The calculation of NMHC and $CH_4$ depends on the calibration method used. The following methods are permitted.**

**(a) calibration gas – propane; propane bypasses NMC,**
**(b) calibration gas – methane; methane passes through NMC**

**The concentration of NMHC and $CH_4$ shall be calculated as follows for method (a):**

$$c_{NMHC} = \frac{c_{HCW} - c_{HCW/O} \times (1 - E_E)}{r_h \times (E_E - E_M)} \quad (67)$$

$$c_{CH4} = \frac{c_{HCW/O} \times (1 - E_M) - c_{HCW}}{E_E - E_M} \quad (68)$$

**The concentration of NMHC and $CH_4$ shall be calculated as follows for method (b):**

$$c_{NMHC} = \frac{(c_{HCW/O}) \times (1 - E_M) - c_{HCW} \times r_h \times (1 - E_M)}{E_E - E_M} \quad (67a)$$

$$c_{CH4} = \frac{c_{HCW} \times r_h \times (1 - E_M) - c_{HCW/O} \times (1 - E_E)}{r_h \times (E_E - E_M)} \quad (68a)$$

where:

$c_{HC(w/NMC)}$ is the HC concentration with sample gas flowing through the NMC, ppm
$c_{HC(w/oNMC)}$ is the HC concentration with sample gas bypassing the NMC, ppm
**$r_h$ is the methane response factor as determined per paragraph 9.3.7.2.**
$E_M$ is the methane efficiency as determined per paragraph 9.3.8.1.
$E_E$ is the ethane efficiency as determined per paragraph 9.3.8.2.

**If $r_h$ < 1.05, it may be omitted in equations 67, 67a and 68a.**

9.3.2.5. Non-methane hydrocarbon (NMHC) analysis

The determination of the non-methane hydrocarbon fraction shall be performed with a heated non-methane cutter (NMC) operated in line with an FID as per Annex 3, paragraph A.3.1.4. by subtraction **of the methane concentration from the total hydrocarbon concentration**. For determination of ~~**NMHC and**~~ $CH_4$, the FID may be calibrated and spanned with $CH_4$ calibration gas **passing through the NMC**.

## D. Editorial

Before submission to WP.29, the draft gtr will be checked for errors and correct references to tables, diagrams and equations. Annex 6 will be amended in line with the revised NMHC and $CH_4$ equations.