United Nations ECE/TRANS/WP.29/2013/113

Economic and Social Council

Distr.: General
26 July 2013

Original: English

Economic Commission for Europe

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

161st session
Geneva, 12-15 November 2013
Item 4.9.3. of the provisional agenda
1958 Agreement – Consideration of draft amendments to existing Regulations submitted by GRPE

Proposal for Supplement 3 to the 01 series of amendments to Regulation No. 101 (CO_2 emissions/fuel consumption)

Submitted by the Working Party on Pollution and Energy*

The text reproduced below was adopted by the Working Party on Pollution and Energy (GRPE) at its sixty-sixth session (ECE/TRANS/WP.29/GRPE/66, para. 30.). It is based on ECE/TRANS/WP.29/GRPE/2013/9, as amended by para. 30. of the GRPE report (ECE/TRANS/WP.29/GRPE/66). It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Administrative Committee AC.1 for consideration.

* In accordance with the programme of work of the Inland Transport Committee for 2010–2014 (ECE/TRANS/208, para. 106 and ECE/TRANS/2010/8, programme activity 02.4), 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.

Paragraph 2.17.1., amend to read:

"2.17.1. "*Hybrid electric vehicle (HEV)*" means a vehicle, including vehicles which draw energy from a consumable fuel only for the purpose of re-charging the electrical energy/power storage device, that, for the purpose of mechanical propulsion, draws energy from both of the following on-vehicle sources of stored energy/power:

(a) A consumable fuel;

(b) A battery, capacitor, flywheel/generator or other electrical energy/power storage device;"

Insert new paragraphs 2.20. and 2.21., to read:

"2.20. "*Flex fuel H2NG vehicle*" means a flex fuel vehicle that can run on different mixtures of hydrogen and NG/biomethane;

2.21. "*Hydrogen fuel cell vehicle*" means a vehicle powered by a fuel cell that converts chemical energy from hydrogen into electric energy, for propulsion of the vehicle."

Paragraph 5.1., split in paragraphs 5.1. and 5.1.1. to read:

"5.1. General

5.1.1. The components liable to affect the emissions of CO_2 and fuel consumption or the electric energy consumption shall be so designed, constructed and assembled as to enable the vehicle, in normal use, despite the vibrations to which it may be subjected, to comply with the provisions of this Regulation."

Insert new paragraphs 5.1.2. and 5.1.3., to read:

"5.1.2. The daytime running lamps of the vehicle as defined in paragraph 2.7.25. of Regulation No 48 shall be switched on during the test cycle if the vehicle is required to be equipped with daytime running lamps as indicated in paragraph 5.22. of Regulation No. 48. The vehicle tested shall be equipped with the daytime running lamp system that has the highest electrical energy consumption among the daytime running lamp systems, which are fitted by the manufacturer to vehicles in the group represented by the type-approved vehicle. The manufacturer shall supply appropriate technical documentation to the type-approval authorities in this respect.

5.1.3. Table A illustrates the application of the test requirements for type approval of a vehicle.

Table A

Application of the test requirements: CO_2 emissions, fuel consumption, electric energy consumption and electric range

Vehicles with positive ignition engines including hybrids			*Test?*
Mono fuel	Petrol (E5)		Yes
	LPG		Yes
	NG/Biomethane		Yes
	Hydrogen		Yes
Bi-fuel[1]	Petrol (E5)	LPG	Yes (both fuels)
	Petrol (E5)	NG/Biomethane	Yes (both fuels)
	Petrol (E5)	Hydrogen	Yes (both fuels)
Flex-fuel[1]	Petrol (E5)	Ethanol (E85)	Yes (both fuels)
	NG/Biomethane	H2NG	Yes (both fuels)
Vehicles with compression ignition engines including hybrids			*Test?*
Flex fuel	Diesel (B5)	Biodiesel	Yes (B5 only)[2]
Mono fuel	Diesel (B5)		Yes
Other vehicles			*Test?*
Pure electric vehicles			Yes
Hydrogen Fuel cell vehicles			Yes

Notes:

[1] When a bi-fuel vehicle is combined with a flex fuel vehicle, both test requirements are applicable.

[2] This provision is temporary, further requirements for biodiesel shall be proposed later on.

"

Paragraph 5.2.3. and 5.2.4., amend to read (leaving footnote 3 unchanged):

"5.2.3. Fuel consumption values must be expressed in litres per 100 km (in the case of petrol, LPG, ethanol (E85) and diesel), in m^3 per 100 km (in the case of NG/biomethane and H2NG) or in kg per 100 km (in the case of hydrogen) and are calculated according to paragraph 1.4.3. of Annex 6. The results will be rounded to the first decimal place.

5.2.4. For the purpose of the calculation mentioned in paragraph 5.2.3., the fuel consumption shall be expressed in appropriate units and the following fuel characteristics shall be used:

(a) Density: measured on the test fuel according to ISO 3675 or an equivalent method. For petrol, diesel, biodiesel and ethanol (E85 and E75) the density measured at 15 ºC will be used; for LPG and natural gas/biomethane a reference density will be used, as follows:

0.538 kg/litre for LPG

0.654 kg/m^3 for NG [3];

(b) Hydrogen-carbon ratio: fixed values will be used which are:

$C_1H_{1.89}O_{0.016}$ for petrol;

$C_1H_{1.86}O_{0.005}$ for diesel;

$C_1H_{2.525}$ for LPG (liquefied petroleum gas);

CH_4 for NG (natural gas) and biomethane;

$C_1H_{2.74}O_{0.385}$ for ethanol (E85);

$C_1H_{2.61}O_{0.329}$ for ethanol (E75)."

Annex 4, items 7.1.2.1. to 7.1.2.3., amend to read (inserting also a new footnote [*]):

"7.1.2.1. Fuel consumption (urban conditions):

..... l/100 km or m^3/100 km or kg/100 km[*]

7.1.2.2. Fuel consumption (extra-urban conditions):

..... l/100 km or m^3/100 km or kg/100 km[*]

7.1.2.3. Fuel consumption (combined):

..... l/100 km or m^3/100 km or kg/100 km[*]

[*] Delete where not applicable (when more than one entry is applicable, there are cases where nothing needs to be deleted)."

Annex 6

The title, amend to read:

"**Method of measuring emissions of carbon dioxide and fuel consumption of vehicles powered by an internal combustion engine only or hydrogen fuel cell vehicles**"

Paragraph 1.1., amend to read:

"1.1. Emissions of carbon dioxide (CO_2) and fuel consumption of vehicles powered by an internal combustion engine only shall be determined according to the procedure for the Type I test as defined in Annex 4a of Regulation No. 83 in force at the time of the approval of the vehicle."

Paragraph 1.3., amend to read:

"1.3. In addition to the conditions specified in Annex 4a of Regulation No. 83...:"

Paragraph 1.4.1., amend to read:

"1.4.1. The mass emission of CO_2, expressed in g/km, shall be calculated from the measurement results using the provisions defined in paragraph 6.6. of Annex 4a to Regulation No. 83 in force at the time of the approval of the vehicle."

Paragraphs 1.4.2. and 1.4.3., amend to read:

"1.4.2. The fuel consumption values shall be calculated from the emissions of hydrocarbons, carbon monoxide, and carbon dioxide determined from the measurement results using the provisions defined in paragraph 6.6. of Annex 4a to Regulation No. 83 in force at the time of the approval of the vehicle.

1.4.3. The fuel consumption, expressed in litres per 100 km (in the case of petrol, LPG, ethanol (E85) and diesel), in m^3 per 100 km (in the case of NG/biomethane and H2NG) or in kg per 100 km (in the case of hydrogen) is calculated by means of the following formulae:

…

(e) for vehicles with a positive ignition engine fuelled with ethanol (E85):

$$FC = (0.1742/D) \cdot [(0.574 \cdot HC) + (0.429 \cdot CO) + (0.273 \cdot CO_2)];$$

(f) For vehicles with a positive ignition engine fuelled by H2NG:

$$FC = \left(\frac{910.4 \cdot A + 13600}{44.655 \cdot A^2 + 667.08 \cdot A}\right) \cdot \left(\left(\frac{7.848 \cdot A}{9.104 \cdot A + 136}\right) \cdot HC + 0.429 \cdot CO + 0.273 \cdot CO_2\right)$$

(g) For vehicles fuelled by gaseous hydrogen:

$$FC = 0.024 \frac{V}{d}\left[\frac{1}{Z_1}\frac{p_1}{T_1} - \frac{1}{Z_2}\frac{p_2}{T_2}\right]$$

Under previous agreement with the type-approval authority, and for vehicles fuelled either by gaseous or liquid hydrogen, the manufacturer may choose as alternative to the method above, either the formula

$FC = 0.1 \cdot (0.1119 \cdot H_2O + H_2)$

for vehicles powered by internal combustion engine only, or a method according to standard protocols such as SAE J2572 or ISO 23828.

In these formulae:

FC	=	The fuel consumption in litre per 100 km (in the case of petrol, ethanol, LPG, diesel or biodiesel) in m^3 per 100 km (in the case of natural gas and H2NG) or in kg per 100 km in the case of hydrogen.
HC	=	The measured emission of hydrocarbons in g/km
CO	=	The measured emission of carbon monoxide in g/km
CO_2	=	The measured emission of carbon dioxide in g/km
H_2O	=	The measured emission of H_2O in g/km
H_2	=	The measured emission of H_2 in g/km
A	=	Quantity of NG/biomethane within the H2NG mixture, expressed in per cent volume
D	=	The density of the test fuel. In the case of gaseous fuels this is the density at 15 °C.
d	=	The theoretical distance covered by a vehicle tested under the Type I test in km.
p_1	=	Pressure in gaseous fuel tank before the operating cycle in Pa;
p_2	=	Pressure in gaseous fuel tank after the operating cycle in Pa;
T_1	=	Temperature in gaseous fuel tank before the operating cycle in K.
T_2	=	Temperature in gaseous fuel tank after the operating cycle in K.
Z_1	=	Compressibility factor of the gaseous fuel at p_1 and T_1
Z_2	=	compressibility factor of the gaseous fuel at p_2 and T_2
V	=	Inner volume of the gaseous fuel tank in m^3

The compressibility factor shall be obtained from the following table:

		T (K)									
		5	*100*	*200*	*300*	*400*	*500*	*600*	*700*	*800*	*900*
p (bar)	*33*	0.859	1.051	1.885	2.648	3.365	4.051	4.712	5.352	5.973	6.576
	53	0.965	0.922	1.416	1.891	2.338	2.765	3.174	3.57	3.954	4.329
	73	0.989	0.991	1.278	1.604	1.923	2.229	2.525	2.81	3.088	3.358
	93	0.997	1.042	1.233	1.47	1.711	1.947	2.177	2.4	2.617	2.829
	113	1	1.066	1.213	1.395	1.586	1.776	1.963	2.146	2.324	2.498
	133	1.002	1.076	1.199	1.347	1.504	1.662	1.819	1.973	2.124	2.271
	153	1.003	1.079	1.187	1.312	1.445	1.58	1.715	1.848	1.979	2.107
	173	1.003	1.079	1.176	1.285	1.401	1.518	1.636	1.753	1.868	1.981
	193	1.003	1.077	1.165	1.263	1.365	1.469	1.574	1.678	1.781	1.882
	213	1.003	1.071	1.147	1.228	1.311	1.396	1.482	1.567	1.652	1.735
	233	1.004	1.071	1.148	1.228	1.312	1.397	1.482	1.568	1.652	1.736
	248	1.003	1.069	1.141	1.217	1.296	1.375	1.455	1.535	1.614	1.693
	263	1.003	1.066	1.136	1.207	1.281	1.356	1.431	1.506	1.581	1.655
	278	1.003	1.064	1.13	1.198	1.268	1.339	1.409	1.48	1.551	1.621
	293	1.003	1.062	1.125	1.19	1.256	1.323	1.39	1.457	1.524	1.59
	308	1.003	1.06	1.12	1.182	1.245	1.308	1.372	1.436	1.499	1.562
	323	1.003	1.057	1.116	1.175	1.235	1.295	1.356	1.417	1.477	1.537
	338	1.003	1.055	1.111	1.168	1.225	1.283	1.341	1.399	1.457	1.514
	353	1.003	1.054	1.107	1.162	1.217	1.272	1.327	1.383	1.438	1.493

In the case that the needed input values for *p* and *T* are not indicated in the table, the compressibility factor shall be obtained by linear interpolation between the compressibility factors indicated in the table, choosing the ones that are the closest to the sought value."

Annex 8

Paragraph 1.1., amend to read:

"1.1. This annex defines the specific provisions regarding type-approval of a hybrid electric vehicle (HEV) as defined in paragraph 2.17.1. of this Regulation."

Paragraphs 1.4.1. to 1.4.3., amend to read:

"1.4.1. For vehicles with a manual transmission the driving cycle described in paragraph 6.1. of Annex 4a to Regulation No. 83 in force at the time of approval of the vehicle shall be used, including the prescribed gear shifting points.

1.4.2. For vehicles with a special gear shifting strategy the gear shifting points prescribed in paragraph 6.1. of Annex 4a to Regulation No. 83 are not applied. For these vehicles the driving cycle specified in paragraph 6.1.3.2. of Annex 4a to Regulation No. 83 in force at the time of approval of the vehicle shall be used. Concerning gear shifting points, these vehicles shall be driven according to the manufacturer's instructions, as incorporated in the drivers' handbook of production vehicles and indicated by a technical gear shift instrument (for drivers information).

1.4.3. For vehicles with an automatic transmission the driving cycle specified in paragraph 6.1.3.2. of Annex 4a to Regulation No. 83 in force at the time of approval of the vehicle shall be used."

Paragraph 3.2.3.4., amend to read:

"3.2.3.4. The exhaust gases shall be analysed according to Annex 4a of Regulation No. 83 in force at the time of approval of the vehicle."

Paragraph 3.3.2.4., amend to read:

"3.3.2.4. The exhaust gases shall be analysed according to Annex 4a of Regulation No. 83 in force at the time of approval of the vehicle."

Paragraph 4.2.4.4., amend to read:

"4.2.4.4. The exhaust gases shall be analysed according to Annex 4a of Regulation No. 83 in force at the time of approval of the vehicle."

Paragraph 4.3.2.4., amend to read:

"4.3.2.4. The exhaust gases shall be analysed according Annex 4a of Regulation No. 83 in force at the time of approval of the vehicle."

Annex 9, paragraph 4.2.2.1.1., amend to read:

"4.2.2.1.1. The applicable test sequence and accompanying gear shift prescription, as defined in paragraph 1.4. of Annex 8, is applied on a chassis dynamometer adjusted as described in Appendices 1, 6 and 7 of Annex 4a to Regulation No. 83, until the end of the test criteria is reached.

…"

Annex 10, paragraph 3.2.1., amend to read:

"3.2.1. Preparation of the vehicle, if required, for the emissions test during a regeneration phase, may be completed using the preparation cycles in paragraph 6.3. of Annex 4A to Regulation No. 83 or equivalent engine test bench cycles, depending on the loading procedure chosen in paragraph 3.1.2. above."