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Item 3(a) of the provisional agenda

Light vehicles: UN Regulations Nos. 68 (Measurement of the maximum speed, including electric vehicles), 83 (Emissions of M₁ and N₁ vehicles), 101 (CO₂ emissions/fuel consumption), 103 (Replacement pollution control devices) and 154 (Worldwide harmonized Light vehicles Test Procedures (WLTP))

Proposal for a new supplement to the 01 series of amendments to UN Regulation No. 154 (Worldwide harmonized Light vehicles Test Procedures (WLTP))

Submitted by the expert from the International Organization of Motor Vehicle Manufacturers* **

The text reproduced below was prepared by the expert from the International Organization of Motor Vehicle Manufacturers (OICA). It proposes to incorporate corrections and clarifications which were identified during the development of the 02 series of amendments. The modifications to the current text of the Resolution are marked in bold for new or strikethrough for deleted characters..

* In accordance with the programme of work of the Inland Transport Committee for 2022 as outlined in proposed programme budget for 2022 (A/76/6 (Sect.20), para 20.76), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

** This document was submitted late for technical reasons.

I. Proposal

Contents, Annexes Part A, Section A1, amend the title to read:

"A1. Engine and vehicle characteristics and information concerning the conduct of tests (**'information document'**)"

Contents, Annexes Part B, Section B8, amend the title of Appendix 8 to read:

"Determination of additional electric energy consumption values required for checking the Conformity of Production of PEVs and OVC-HEVs"
~~Calculation of additional values required for checking the Conformity of Production of electric energy consumption of PEVs and OVC-HEVs 522"~~

Paragraph 2.1., amend to read:

"2.1. General abbreviations

AC	Alternating current
APF	Assigned permeability factor
BWC	Butane working capacity
CD	Charge Depleting
CFD	Computational fluid dynamics
CFV	Critical flow venturi
CFO	Critical flow orifice
CLA	Chemiluminescent analyser
CS	Charge Sustaining
CVS	Constant volume sampler
.....
PER	Pure electric range
Per cent FS	Per cent of full scale
PF	Permeability factor
....."

Paragraph 3.2.7., remove the full stop after the referenced paragraph number to read:

"3.2.7. *"Maximum vehicle load"* means the technically permissible maximum laden mass minus the mass in running order, 25 kg and the mass of the optional equipment as defined in paragraph 3.2.8.:"

Paragraph 3.2.36., amend to read:

"3.2.36. *"Coasting"* means a functionality of either an automatic transmission or a clutch which, **when no propulsion or a slow reduction of speed is needed,** decouples the engine from the drivetrain automatically **and neither a propulsion energy is applied to the wheels nor recuperation energy is taken from the wheels nor friction braking is applied.** ~~when no propulsion or a slow reduction of speed is needed and~~ **during application of this function which** the engine may be idling or switched off. "

Insert new paragraph 3.2.37., to read:

"3.2.37. *"Reference mass"* means the vehicle's mass in running order less the uniform mass of the driver of 75 kg and increased by a uniform mass of 100 kg."

Paragraph 3.3.10.3., add a full stop to the numbering to read:

"3.3.10.3. "Form of energy" means (i) electrical energy, or (ii) mechanical energy, or (iii) chemical energy (including fuels). "

Paragraph 3.5.12., replace the apostrophies with speech marks to read:

"3.5.12. "'Configurable start mode'" for the purpose of this Regulation means a driver-selectable mode that can be set by the driver as a mode which is automatically selected when the vehicle is switched on. After the vehicle is switched on, the configurable start mode can only be switched to another mode by an intentional action of the driver. "

Paragraph 3.11.1., add a full stop to the numbering and amend to read:

"3.11.1. "Active heat storage device" means a technology that stores heat within any device of a vehicle and releases the heat to a ~~power-train~~ **powertrain** component over a defined time period at engine start. It is characterised by the stored enthalpy in the system and the time for heat release to the ~~power-train~~ **powertrain** components. "

Paragraph 3.11.2., amend the font of the speech marks to read:

"3.11.2. "'Insulation materials'" means any material in the engine compartment attached to the engine and/or the chassis with a thermal insulation effect and characterised by a maximum heat conductivity of 0.1 W/(mK). "

Paragraph 5.2.1., amend the font of the speech marks to read:

"5.2.1. The type approval number shall consist of four sections. Each section shall be separated by the '*' character.

Section 1: The capital letter 'E' followed by the distinguishing number of the Contracting Party which has granted the type approval¹.

Section 2: The number ~~of this UN Regulation, 154~~, followed by the letter 'R', successively followed by:

....."

Insert new paragraph 6.1.10., to read:

"6.1.10. Division by zero

In the case that the data input to a formula in this Regulation justifiably leads to division by zero, e.g. when an OVC-HEV consumes zero fuel under charge depleting conditions, good engineering judgement shall be applied by the responsible authority."

Paragraph 6.2.6., add new sub-paragraph (k) to read:

"6.2.6. Each of the vehicle families specified below shall be attributed a unique identifier of the following format:

FT-nnnnnnnnnnnnnnnn-WMI

Where:

FT is an identifier of the family type:

- (a) IP = Interpolation family as defined in paragraph 6.3.2. with or without using the interpolation method
- (b) RL = Road load family as defined in paragraph 6.3.3.
- (c) RM = Road load matrix family as defined in paragraph 6.3.4.

¹ The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.6, www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html.

- (d) PR = Periodically regenerating systems (K_i) family as defined in paragraph 6.3.5.
- (e) AT = ATCT family as defined in paragraph 2. of Annex B6a.
- (f) EV = Evaporative emissions family, as defined in paragraph 6.6.3.
- (g) DF = Durability family, as defined in paragraph 6.7.5.
- (h) OB = OBD family identifier, as defined paragraph 6.8.1.
- (i) ER = Exhaust after-treatment system using reagent (ER) family identifier, as defined in paragraph 6.9.2.
- (j) GV = GFV family identifier, as defined in paragraph 6.3.6.3.
- (k) **KC = K_{CO2} family identifier, as defined in paragraph 6.3.11.**

nnnnnnnnnnnnnn is a string with a maximum of fifteen characters, restricted to using the characters 0-9, A-Z and the underscore character '_'.

WMI (world manufacturer identifier) is a code that identifies the manufacturer in a unique manner defined in ISO 3780:2009.

It is the responsibility of the owner of the WMI to ensure that the combination of the string nnnnnnnnnnnnnnn and the WMI is unique to the family and that the string nnnnnnnnnnnnnnn is unique within that WMI to the approval tests performed to obtain the approval."

Paragraph 6.3.2.1.2., amend to read:

"6.3.2.1.2. Only vehicles that are identical with respect to the following vehicle/~~powertrain~~**powertrain**/transmission characteristics may be part of the same interpolation family:

- (a) Type of internal combustion engine: fuel type (or types in the case of flex-fuel or bi-fuel vehicles), combustion process, engine capacity, full-load characteristics, engine technology, and charging system, and also other engine subsystems or characteristics that have a non-negligible influence on CO₂ ~~mass~~ emission under WLTP conditions;
- (b) Operation strategy of all CO₂ ~~mass~~ emission influencing components within the powertrain;
- (c) Transmission type (e.g. manual, automatic, CVT) and transmission model (e.g. torque rating, number of gears, number of clutches, etc.);
- (d) n/v ratios (engine rotational speed divided by vehicle speed). This requirement shall be considered fulfilled if, for all transmission ratios concerned, the difference with respect to n/v ratios of the most commonly installed transmission type is within 8 per cent;
- (e) Number of powered axles."

Paragraph 6.3.3., delete sub-paragraph (b), renumber sub-paragraph (c) as (b), replacing the semi-colon with a full stop and remove the indent from the following text to read:

"6.3.3. Road load family

Only vehicles that are identical with respect to the following characteristics may be part of the same road load family:

- (a) Transmission type (e.g. manual, automatic, CVT) and transmission model (e.g. torque rating, number of gears, number of clutches, etc.).
At the request of the manufacturer and with approval of the responsible

authority, a transmission with lower power losses may be included in the family;

~~(b) n/v ratios (engine rotational speed divided by vehicle speed). This requirement shall be considered fulfilled if, for all transmission ratios concerned, the difference with respect to the transmission ratios of the most commonly installed transmission type is within 25 per cent;~~

(eb) Number of powered axles;

~~If at least one electric machine is coupled in the gearbox position neutral and the vehicle is not equipped with a coastdown mode (paragraph 4.2.1.8.5. of Annex B4) such that the electric machine has no influence on the road load, the criteria in paragraph 6.3.2.2. (a) and paragraph 6.3.2.3. (a) shall apply.~~

~~If there is a difference, apart from vehicle mass, rolling resistance and aerodynamics, that has a non-negligible influence on road load, that vehicle shall not be considered to be part of the family unless approved by the responsible authority.~~

If at least one electric machine is coupled in the gearbox position neutral and the vehicle is not equipped with a coastdown mode (paragraph 4.2.1.8.5. of Annex B4) such that the electric machine has no influence on the road load, the criteria in paragraph 6.3.2.2. (a) and paragraph 6.3.2.3. (a) shall apply.

If there is a difference, apart from vehicle mass, rolling resistance and aerodynamics, that has a non-negligible influence on road load, that vehicle shall not be considered to be part of the family unless approved by the responsible authority."

In Table 1B, change the letter t in technically to a capital letter, remove the reference to N₂ vehicles and delete the empty last row to read:

"Table 1B

Emissions limits for the Type 1 test which apply to the emissions from the first 3 phases of a WLTP test

Category	Class	technically Technically permissible maximum laden mass (GVW) (kg)	Limit values												
			Mass of carbon monoxide (CO)		Mass of non- methane hydrocarbons (NMHC)		Mass of oxides of nitrogen (NO _x)			Mass of particulate matter (PM)					
			L ₁ (mg/km)		L ₃ (mg/km)		L ₄ (mg/km)			L ₅ (mg/km)					
			G, O	D			G, O	D	G	D	O			G*1, O	D
M	—	All	1,150	630			100	24	50	150	150			5	5
N ₁ , N₂	—*2	GVW ≤ 1,700	1,150	630			100	24	50	150	150			5	5
	—	1,700 < GVW ≤ 3,500	2,550	630			150	24	70	240	240			7	7
	—*3	All	4,020	—			100	—	50	—	150			5	—

G Petrol, LPG

D Diesel

O Other fuel

¹ For petrol or LPG, particulate mass limits shall apply only to vehicles with direct injection engines.

² Except vehicles having engine displacement less than or equal to 0.660 litre, vehicle length less than or equal to 3.40m, vehicle width less than or equal to 1.48m, and vehicle height less than or equal to 2.00m, seats less than or equal to 3 in addition to a driver, and payload less than or equal to 350kg.

³ Vehicles having engine displacement less than or equal to 0.660 litre, vehicle length less than or equal to 3.40m, vehicle width less than or equal to 1.48m, and vehicle height less than or equal to 2.00m, seats less than or equal to 3 in addition to a driver, and payload less than or equal to 350kg."

Insert new paragraph 6.3.11., to read:

"6.3.11. K_{CO2} correction factor family for OVC-HEVs and NOVC-HEVs

It is allowed to merge two or more interpolation families into the same K_{CO2} correction factor family if newly merged interpolation families meet at least one of the following criteria defined in (a) to (e) of this paragraph. The representative K_{CO2} shall be determined with preferably highest energy demand vehicle H within a family.

At the request of the responsible authority, the manufacturer shall provide evidence on the justification and technical criteria for merging these interpolation families in the following cases:

Two or more interpolation families are merged:

- (a) Which were split because the maximum interpolation range of 20 g/km CO₂ is exceeded (in case vehicle M measured: 30 g/km);
- (b) Which were split due to different engine power ratings of the same physical combustion engine (different power only related to software);
- (c) Which were split because the n/v ratios are just outside the tolerance of 8 per cent;
- (d) Which were split, but still fulfil all the family criteria of a single IP family;
- (e) Which were split because there is a different number of powered axles.

Different electric energy converters between recharge-plug-in and traction REESS shall not be considered as a criterion in the context of the correction factor family."

Replace Table 3b with a new table with footnotes, to read:

"Table 3b

Additive Deterioration factors (for emissions measurements to be compared against the limits in Table 1B)

Engine Category	Assigned additive deterioration factors					
	CO		NMHC	NO _x		PM
Gasoline fuel and LPG	0.11		0.12	0.21		0.00
Compression-ignition	As there are no assigned deterioration factors for compression ignition vehicles, manufacturers shall use the whole vehicle ageing durability test procedures to establish deterioration factors.					

Technically Permissible Maximum Laden Mass (GVW) (kg)	Assigned additive deterioration factors			
	Mass of carbon monoxide (CO)	Mass of non-methane hydrocarbons (NMHC)	Mass of oxides of nitrogen (NO _x)	Mass of particulate matter (PM)

			L_1 (mg/km)		L_3 (mg/km)		L_4 (mg/km)			L_5 (mg/km)	
Category	Class		G	D, O	G	D, O	G	D	O	G*I	D, O
M	—	All	127		12		11		*4	0	
N ₁	—*2	GVW ≤ 1,700	127	*4	12	*4	11	*4		0	*4
	—	1,700 < GVW ≤ 3,500	281		18		15			0	
	—*3	All	327	—	9	—	8	—		0	—

G Petrol, LPG

D Diesel

O Other fuel

- ¹ For petrol or LPG, particulate mass and particle number limits shall apply only to vehicles with direct injection engines.
- ² Except vehicles having engine displacement less than or equal to 0.660 litre, vehicle length less than or equal to 3.40m, vehicle width less than or equal to 1.48m, and vehicle height less than or equal to 2.00m, seats less than or equal to 3 in addition to a driver, and payload less than or equal to 350kg.
- ³ Vehicles having engine displacement less than or equal to 0.660 litre, vehicle length less than or equal to 3.40m, vehicle width less than or equal to 1.48m, and vehicle height less than or equal to 2.00m, seats less than or equal to 3 in addition to a driver, and payload less than or equal to 350kg.
- ⁴ As there are no assigned deterioration factors for compression ignition vehicles, manufacturers shall use the whole vehicle ageing durability test procedures to establish deterioration factors."

Add new paragraph 6.7.2.1., to read:

"6.7.2.1. This paragraph is applicable for emissions measurements to be compared against the limits in Table 1B only

In case that the limit value is different from the value defined in Table 1B, the assigned additive deterioration factor shall be calculated using the following equation and shall be rounded according to approval authority instruction:

the assigned additive deterioration factor = Limit value * A * (Useful life – 3,000)/(80,000 – 3,000)

where :

A 0.11 for CO, 0.12 for NMHC, 0.21 for NO_x and 0.00 for PM and PN."

Paragraph 6.7.5., amend sub-paragraph (a) (ii) to read:

"6.7.5. Durability family

Only vehicles whose engine or pollution control system parameters are identical or remain within the prescribed tolerances with reference to the vehicle used for the determination of the Deterioration Factor may be part of the same Durability family:

(a) Engine

- (i) Ratio between engine cylinder capacity and the volume of each catalytic component and/or filter (-10 to +5 per cent);
- (ii) Difference in engine capacity within either ±15 per cent of the capacity of the tested vehicle or ±820 cm³ whichever value presents the least difference ~~is lower~~;
- (iii) "

Table 4B, remove the reference to N₂ vehicles to read:

"Table 4B

OBD thresholds

		Reference mass (RM) (kg)	Mass of carbon monoxide		Mass of non-methane hydrocarbons		Mass of oxides of nitrogen		Mass of particulate matter ¹	
			(CO) (mg/km)		(NMHC) (mg/km)		(NO _x) (mg/km)		(PM) (mg/km)	
Category	Class		G	D	G	D	G	D	G	D
M	—	All	4,060	—	320	—	300	—	—	—
N ₁ - N₂	—* ¹	GVW ≤ 1,700	4,060	—	320	—	300	—	—	—
	—	1,700 < GVW ≤ 3,500	8,960	—	460	—	410	—	—	—
	—* ²	All	14,120	—	320	—	300	—	—	—

G Petrol, LPG

D Diesel

- ¹ Except vehicles having engine displacement less than or equal to 0.660 litre, vehicle length less than or equal to 3.40 m, vehicle width less than or equal to 1.48 m, and vehicle height less than or equal to 2.00 m, seats less than or equal to 3 in addition to a driver, and payload less than or equal to 350 kg
- ² Vehicles having engine displacement less than or equal to 0.660 litre, vehicle length less than or equal to 3.40 m, vehicle width less than or equal to 1.48 m, and vehicle height less than or equal to 2.00 m, seats less than or equal to 3 in addition to a driver, and payload less than or equal to 350 kg"

Paragraph 7.4.1., amend to read:

"7.4.1. The type-approval shall be extended without the need for further testing to vehicles if they conform to the criteria of paragraph 3.0.1. (a) and (c).

Additionally to the criteria above, in the cases when the Interpolation Family Vehicle High and/ or Vehicle Low are changed, the new Vehicle High and/or Vehicle Low shall be tested and the CO₂ emission **values** of the tested vehicle resulting from step 9 of Table A7/1 of Annex B7 and step 8 of Table A8/5 in Annex B8 shall be less than or equal to the CO₂ emission which lies on a straight line through the CO₂ values of the original Vehicles Low and High when plotted against cycle energy and corresponding to the cycle energy demand of the tested vehicle.

The measured criteria "

Paragraph 7.6.2., amend to read:

"7.6.2. The temperature at the inlet of the pollution control device shall be lower than the temperature of the vehicle tested for DF determination plus 50°C. It shall be checked under following stabilized conditions. A vehicle meeting the requirements of paragraph 1.2. of Annex C4 for the extended durability family shall be brought to a speed of **120 km/h** or the maximum vehicle speed minus 10km/h or ~~120 km/h~~, whichever is lower, and kept at that constant speed for at least 15 minutes at the load setting of the Type 1 test. At any time after this period, the temperature at catalyst inlet shall be measured for at least 2 continued minutes while the vehicle is kept at that constant speed and the average temperature value shall be taken as representative value."

Paragraph 8.1.4.5., amend to read:

"8.1.4.5. The planned production volume of the CoP family per a-12-month period shall be monitored by the manufacturer on a monthly basis, and the responsible authority shall be informed if any change in the planned production volume

causes changes to either the size of the CoP family or the Type 1 test frequency."

Paragraph 8.1.5., amend to read:

"8.1.5. Test frequency for the Type 4 test

Once per year a vehicle shall be randomly taken from the CoP family described in paragraph 8.1.3.2. and subjected to **the test described in Annex C3 or as an alternative at least** the three tests described in Appendix 4."

Paragraph 8.2.3.2., remove the full stop after the reference to Appendix 2 to read:

"8.2.3.2. The statistical procedure for calculating the test criteria and to arrive at a pass or fail decision is described in Appendix 2 and in the flowchart of Figure 8/1.

Where applicable, in accordance with Table 8/1, the production of a CoP family shall be deemed to not conform when a fail decision is reached in accordance with the test criteria in Appendix 2- for one or more of the criteria emissions, CO₂ emissions, fuel efficiency or electric energy consumption.

Where applicable, "

Paragraph 8.3.1., amend to read:

"8.3.1. The production shall be deemed to conform if the vehicle selected and tested according to paragraph 8.1.5. meets the requirements **of paragraph 6.6.2., or the requirements of Appendix 4 as applicable** of all of these tests."

Paragraph 8.3.2., amend to read:

"8.3.2. If the vehicle tested does not satisfy the requirements of paragraph 8.3.1., a further random sample of four vehicles shall be taken from the same family without unjustified delay and subjected to the **Type 4 test tests** described in **Annex C3 or as an alternative at least the tests described in** Appendix 4.

The production shall be deemed to conform if the requirements are met for at least three of these vehicles within 6 months after the initial failed test has been detected."

Paragraph 8.3.3., add a full stop after the word 'applied' and amend to read:

"8.3.3. If the vehicles tested do not satisfy the requirements of paragraph 8.3.2., a further random sample shall be taken from the same family without unjustified delay and subjected to the **Type 4 test tests** described in Annex C3.

If the vehicle tested does not satisfy the requirements of Annex C3, a further random sample of four vehicles shall be taken from the same family and also subjected without unjustified delay to the **Type 4 test tests** described in Annex C3.

On request of the manufacturer, for CoP tests described in Annex C3 the Permeability Factor (PF) derived at Type Approval or the Assigned Permeability Factor (APF) may be applied.

The production shall be deemed to conform if the requirements are met for at least three of these vehicles within 24 months after the initial failed test has been detected."

Renumber paragraph 8.3.3.1. to 8.3.4., insert a comma after the word 'manufacturer' to read:

"8.3.3.14. For CoP tests described in Annex C3 which are performed on a vehicle which has completed a mileage of less than 20,000 km a canister which has been aged according to paragraph 5.1. of Annex C3 shall be used. This can be the original canister from the test vehicle or another canister of identical specification. On request of the manufacturer, for these tests either the Permeability Factor (PF) as defined in the paragraph 5.2. of Annex C3 which was established at Type

Approval for the evaporative family or the Assigned Permeability Factor (APF) also defined in the paragraph 5.2. of Annex C3 shall be applied."

Renumber paragraph 8.3.3.2. to 8.3.5., to read:

"~~8.3.3.2.5.~~ On request of the manufacturer, CoP tests"

Paragraph 8.4.3., amend to read:

"8.4.3. If the vehicle tested does not satisfy the requirements of **paragraph section 8.4.1.**, a further random sample of four vehicles shall be taken from the same family and subjected to the tests described in Appendix 1 to Annex C5. The tests may be carried out on vehicles which have completed a maximum of 15,000 km with no modifications."

Paragraph 12.1., amend to read:

"12.1. As from the official date of entry into force of the 01 series of amendments to this Regulation, and by way of derogation to the obligations of Contracting Parties, the Contracting Parties applying this Regulation and also applying ~~the 08 or a later series of amendments to~~ UN Regulation No. 83 may refuse to accept type approvals granted on the basis of this Regulation which are not accompanied by an approval to the 08 or a later series of amendments to UN Regulation No. 83."

Appendix 1, paragraph 1.4., amend to read:

"1.4. The **criteria emissions** test results shall be ~~the values calculated~~ **determined according to:**
Step 9 of Table A7/1 of Annex B7 for pure ICE vehicles ~~according to Step 9 of Table A7/1 of Annex B7;~~ ;
 Step 8 of Table A8/5 of Annex B8 for NOVC-HEVs and **charge-sustaining condition of OVC-HEVs**;
 and ~~according to Step 6 of Table A8/8 of Annex B8 for the charge-depleting condition of OVC-HEV~~**criteria emissions.**
 Conformity against the applicable criteria emissions limits shall be checked using the pass/fail criteria specified in paragraph 6.3.10. of this Regulation."

Appendix 1, paragraph 2., amend to read:

"2. Verification of CoP on CO₂ ~~mass~~ emissions/ fuel efficiency of pure ICE vehicles"

Appendix 1, paragraph 2.2., amend to read:

"2.2. ~~During this test, t~~The CO₂ ~~mass~~ emission M_{CO₂,c,6} shall be determined according to step 6 of Table A7/1 of Annex B7.

~~During this test, t~~The fuel efficiency FE_{c,5} shall be determined according to step 5 of Table A7/1 of Annex B7."

Appendix 1, paragraph 2.3., amend to read:

"2.3. The conformity of production with regard to CO₂ ~~mass~~ emissions shall be verified on the basis of the values for the tested vehicle as described in paragraph 2.3.1. and applying a run-in factor as defined in paragraph 8.2.4. of this Regulation.

The conformity of production with regard to fuel efficiency shall be verified on the basis of the values for the tested vehicle as described in paragraph 1.3.1. and applying a run-in factor as defined in paragraph 8.2.4. of this Regulation."

Appendix 1, paragraph 2.3.1., amend to read:

"2.3.1. CO₂ ~~mass~~ emission values for CoP / Fuel efficiency values for CoP

In the case the interpolation method is not applied, the CO₂ ~~mass~~ emission value M_{CO₂,c,7} according to step 7 of Table A7/1 of Annex B7 shall be used for verifying the conformity of production.

In the case the interpolation method is applied, the CO₂ ~~mass~~ emission value $M_{CO_2,c,ind}$ for the individual vehicle according to step 10 of Table A7/1 of Annex B7 shall be used for verifying the conformity of production.

In the case"

Appendix 1, paragraph 3., amend to read:

"3. Verification of CoP on CO₂ ~~mass~~ emissions/ fuel efficiency of NOVC-HEVs"

Appendix 1, paragraph 3.2., amend to read:

"3.2. ~~During this test, t~~The CO₂ ~~mass~~ emission $M_{CO_2,CS,c,6}$ of the NOVC-HEV shall be determined according to step 6 of Table A8/5 of Annex B8.

~~During this test, t~~The fuel efficiency $FE_{CS,c,4c}$ of the NOVC-HEV shall be determined according to step 4c of Table A8/5 of Annex B8. "

Appendix 1, paragraph 3.3., amend to read:

"3.3. The conformity of production with regard to CO₂ ~~mass~~ emissions or fuel efficiency, as applicable, shall be verified on the basis of the values for the tested vehicle as described in paragraph 3.3.1. and applying a run-in factor as defined in paragraph 8.2.4. of this Regulation."

Appendix 1, paragraph 3.3.1., amend to read:

"3.3.1. CO₂ ~~mass~~ emission values for CoP / Fuel efficiency values for CoP

In the case the interpolation method is not applied, the charge-sustaining CO₂ ~~mass~~ emission value $M_{CO_2,CS,c,7}$ according to step 7 of Table A8/5 of Annex B8 shall be used for verifying the conformity of production.

In the case the interpolation method is applied, the charge-sustaining CO₂ ~~mass~~ emission value $M_{CO_2,CS,c,ind}$ for the individual vehicle according to step 9 of Table A8/5 of Annex B8 shall be used for verifying the conformity of production.

In the case"

Appendix 1, paragraph 4.1., amend to read:

"4.1. The vehicle shall be tested as described in paragraph 3.4. of Annex B8. ~~During the conformity of production verification,~~ whilst the break-off criterion for the Type 1 test procedure according to paragraph 3.4.4.1.3. of Annex B8 (consecutive cycle procedure) and paragraph 3.4.4.2.3. of Annex B8 (Shortened Test Procedure) shall be considered **to have been** reached when having finished the first applicable WLTP test cycle.

~~During this test cycle, t~~The DC electric energy consumption from the REESS(s) $EC_{DC,first,i}$ shall be determined according to paragraph 4.3 of Annex B8 where $\Delta E_{REESS,j}$ shall be the electric energy change of all REESS and d_j shall be the actual driven distance during this test cycle."

Appendix 1, paragraph 5., amend to read:

"5. Verification of CoP ~~on CO₂ mass emissions / fuel efficiency and electric consumption~~ of OVC-HEVs"

Appendix 1, paragraph 5.2., amend to read:

"5.2. Verification of the charge-sustaining CO₂ ~~mass~~ emissions / fuel efficiency, as applicable, for conformity of production."

Appendix 1, paragraph 5.2.2., amend to read:

"5.2.2. ~~During this test, t~~The charge-sustaining CO₂ ~~mass~~ emission $M_{CO_2,CS,c,6}$ shall be determined according to step 6 of Table A8/5 of Annex B8.

~~During this test, t~~The charge-sustaining fuel efficiency $FE_{CS,c,4c}$ shall be determined according to step 4c of Table A8/5 of Annex B8."

Appendix 1, paragraph 5.2.3., amend to read:

"5.2.3. The conformity of production with regard to charge-sustaining CO₂ ~~mass~~ emissions shall be verified on the basis of the values for the tested vehicle as described in paragraph 5.2.3.1. for charge-sustaining CO₂ ~~mass~~ emissions, and applying a run-in factor as defined in paragraph 8.2.4. of this Regulation.

The conformity of production"

Appendix 1, paragraph 5.2.3.1., amend to read:

"5.2.3.1. Charge-Sustaining CO₂ ~~mass~~ emission / fuel efficiency values for CoP

In the case the interpolation method is not applied, the charge-sustaining CO₂ ~~mass~~ emission value $M_{CO_2,CS,c,7}$ according to step 7 of Table A8/5 of Annex B8 shall be used for verifying the conformity of production.

In the case the interpolation method is applied, the charge-sustaining CO₂ ~~mass~~ emission value $M_{CO_2,CS,c,ind}$ for the individual vehicle according to step 9 of Table A8/5 of Annex B8 shall be used for verifying the conformity of production.

In the case that the interpolation"

Appendix 1, paragraph 5.3.1.2.1., amend to read:

"5.3.1.2.1. The vehicle shall be tested according to the charge-depleting Type 1 test as described in paragraph 3.2.4. of Annex B8, ~~whilst while~~ the break-off criterion of the charge-depleting Type 1 test procedure shall be considered **to have been** reached when having finished the first applicable WLTP test cycle ~~and replace the break-off criterion of the charge-depleting Type 1 test procedure according to paragraph 3.2.4.4. of Annex B8.~~

~~During this test cycle, t~~The DC electric energy consumption from the REESS(s) $EC_{DC,first,i}$ shall be determined according to paragraph 4.3. of Annex B8 where $\Delta E_{REESS,j}$ shall be the electric energy change of all REESS and d_j shall be the actual driven distance during this test cycle."

Appendix 2, paragraph 2.1., add a full stop after the paragraph number and amend to read:

"2.1. For the criteria emissions from the 4 phases of a WLTP test:

For the total number of ~~N~~ tests (**N**) and the measurement results of the tested vehicles, x_1, x_2, \dots, x_N , the average X_{tests} and the variance VAR shall be determined:

$$X_{tests} = \frac{(x_1 + x_2 + x_3 + \dots + x_N)}{N}$$

and

$$VAR = \frac{(x_1 - X_{tests})^2 + (x_2 - X_{tests})^2 + \dots + (x_N - X_{tests})^2}{N - 1}$$

For OVC-HEV, in case of complete charge-depleting Type 1 test, the average emissions over the complete test of an individual vehicle shall be considered as a single value x_i .

For each **total** number of tests, one of the three following decisions can be reached for criteria emissions, based on the criteria emission limit value L according to Table 1A in paragraph 6.3.10. of this Regulation:

(i) Pass the family"

Appendix 2, paragraph 2.1., amend the title of Table A2/1 to read (Title remains bold font):

"Table A2/1

Pass/fail decision **criteria number** for the sample size"

Appendix 2, paragraph 2.1., amend the final text to read:

"....."

Remarks:

The following recursive formulae are useful for computing successive values of the test statistic:

$$\bar{d}_n = \left(1 - \frac{1}{n}\right) \bar{d}_{n-1} + \frac{1}{n} d_n$$

$$V_n^2 = \left(1 - \frac{1}{n}\right) V_{n-1}^2 + \left[\frac{\bar{d}_n - d_n}{n-1} \right]^2$$

$$V_n^2 = \left(1 - \frac{1}{n}\right) V_{n-1}^2 + \frac{(\bar{d}_n - d_n)^2}{n-1}$$

($n = 2, 3, \dots$; $\bar{d}_1 = d_1$; $V_1 = 0$)"

Appendix 2, paragraphs 3.1. to 3.1.2., amend to read:

"3.1. Statistical procedure

3.1.1. For the CO₂ emissions and electric energy consumption from the 4 phases of a WLTP test:

For the total number of ~~N~~-tests (**N**) and the measurement results of the tested vehicles, x_1, x_2, \dots, x_N , the average X_{tests} and the standard deviation s shall be determined:

$$X_{tests} = \frac{(x_1 + x_2 + x_3 + \dots + x_N)}{N}$$

and

$$s = \sqrt{\frac{(x_1 - X_{tests})^2 + (x_2 - X_{tests})^2 + \dots + (x_N - X_{tests})^2}{N - 1}}$$

3.1.2. For fuel efficiency and electric energy consumption from the first 3 phases of a WLTP test:

For the total number of ~~N~~-tests (**N**) and the measurement results of the tested vehicles, x_1, x_2, \dots, x_N , the average X_{tests} and the standard deviation σ shall be determined:

$$X_{testsN} = \frac{(x_1 + x_2 + x_3 + \dots + x_N)}{N}$$

and"

$$\sigma = \sqrt{\frac{(x_1 - X_{tests})^2 + (x_2 - X_{tests})^2 + \dots + (x_{10} - X_{tests})^2}{10}}$$

"

Appendix 2, paragraphs 3.2.1., amend to read:

"3.2.1. For the CO₂ emissions and electric energy consumption from the 4 phases of a WLTP test:

For the evaluation of CO₂ emissions the normalised values shall be calculated as follows:

$$x_i = \frac{CO_2 \text{ test-}i}{CO_2 \text{ declared-}i}$$

where:

$CO_{2\text{ test-}i}$ is the CO_2 emission measured for **the** individual vehicle i

$CO_{2\text{ declared-}i}$ is the declared CO_2 value for the individual vehicle i

For the evaluation"

Appendix 2, paragraph 3.3.1., amend to read:

"3.3.1. Evaluation of CO_2 emissions and electric energy consumption from the 4 phases of a WLTP test

For each **total** number of tests, one of the three following decisions can be reached, where the factor A shall be set at 1.01:

(i) Pass the"

Appendix 2, Table A2/3, amend the title to read (Title remains bold font):

"Table A2/3

Pass/fail decision **criteria number** for the sample size

....."

Appendix 2, paragraph 3.3.2.1., amend to read:

"3.3.2.1. For the evaluation

.....

(e.g. If the **total number of** vehicles tested for the first evaluation is 11 and the **total number of** vehicles tested for the second evaluation is 4, $N_{\text{Evaluation}}=4$ and $N_{\text{CoP family}}=15$)

In any case, if $N_{\text{CoP family}} > 10$, $x_i \geq 1.000 - 3 * \sigma$ shall be satisfied."

Appendix 3, add new paragraph 1.2.1., to read:

"**1.2.1. Extension of run-in factor**

At the request of the vehicle manufacturer and with approval by the responsible authority, the derived run-in factor for pollutant emissions, fuel efficiency and fuel consumption can be extended to other CoP families.

The vehicle manufacturer shall provide evidence on the justification and technical criteria for merging these COP families, ensuring that there is a large similarity between those families."

Appendix 3, paragraph 1.3., amend to read:

"1.3. The test vehicle shall

. electric energy consumption.

For the new vehicle, or the used vehicle for which the above mentioned components have been replaced, the system odometer of the test vehicle D_s in km shall **be** recorded."

Appendix 3, paragraph 1.6., amend to read:

"1.6. Before the run-in, the test vehicle shall be tested according to the Type 1 test procedure specified in Annex B6 and Annex B8. The test shall be repeated until three valid test results have been obtained. Drive trace indexes shall be calculated according to paragraph 7. of Annex B7 and these shall fulfil the ~~specified~~ criteria **specified** in paragraph 2.6.8.3.1.4. of Annex B6. The system odometer setting D_i shall be recorded prior to each test. The measured criteria emissions, CO_2 emissions, fuel efficiency and electric energy consumption shall be calculated according to Step 4a of Table A7/1 in Annex B7 or Step 4a of Table A8/5 in Annex B8-.

The signal of the"

Appendix 3, paragraph 1.8., amend to read:

- "1.8. After the run-in, the test vehicle shall be tested according to the Type 1 test procedure specified in Annex B6 and Annex B8. The test shall be repeated until three valid test results have been obtained:

Drive trace indexes shall be calculated according to paragraph 7. of Annex B7 and these shall fulfil the ~~specified~~ criteria **specified** in paragraph 2.6.8.3.1.4. of Annex B6.

These tests shall"

Appendix 3, paragraph 1.9., amend to read:

- "1.9. For the determination of the run-in factor for the CO₂ emissions, the coefficients C_{RI} and C_{const} in the following equation shall be calculated by a least squares regression analysis to four significant digits on all valid tests before and after the run-in:

$$M_{CO_2,i} = -C_{RI} \cdot \ln(D_i - D_s) + C_{const}$$

where:

M_{CO₂,i} is the measured CO₂ ~~mass~~ emission for test i, g/km

C_{RI} is the slope of the logarithmic regression line

C_{const} is the constant value of the logarithmic regression line

In the case that multiple vehicles have been tested, the C_{RI} shall be calculated for each vehicle, and the resulting values shall be averaged. The manufacturer will provide statistical evidence to the responsible authority that the fit is sufficiently statistically justified."

Appendix 4, paragraph 1., amend to read:

- "1. For routine end-of-production-line testing, **as an alternative to conducting the Type 4 test as described in Annex C3** the holder of the approval may demonstrate compliance by sampling vehicles which shall meet the requirements in paragraphs 2. to 4. of this appendix."

Appendix 5, paragraph 2.8., amend to read:

- "2.8. ~~"Charge~~**Charge-sustaining operation**" means, for OVC-HEVs, the state of vehicle operation when the REESS state of charge (SOC) may fluctuate but the intent of the vehicle control system is to maintain, on average, the current state of charge."

Appendix 5, paragraph 2.9., amend to read:

- "2.9. ~~"Charge~~**Charge-depleting operation**" means, for OVC-HEVs, the state of vehicle operation when the current REESS SOC is higher than the ~~charge~~**charge-sustaining target SOC** value and, while it may fluctuate, the intent of the vehicle control system is to deplete the SOC from a higher level down to the ~~charge~~**charge-sustaining target SOC** value."

Appendix 5, paragraph 2.10., amend to read:

- "2.10. ~~"Driver-selectable charge~~**charge-increasing operation**" means, for OVC-HEVs, the operating condition in which the driver has selected a mode of operation, with the intention to increase the REESS SOC."

Appendix 5, paragraph 3.2., amend to read:

- "3.2. For OVC-HEVs:
- (a) Total fuel consumed (lifetime) (litres);

- (b) Total fuel consumed in ~~charge~~-**charge**-depleting operation (lifetime) (litres);
- (c) Total fuel consumed in driver-selectable ~~charge~~-**charge**-increasing operation (lifetime) (litres);
- (d) Total distance travelled (lifetime) (kilometres);
- (e) Total distance travelled in ~~charge~~-**charge**-depleting operation with engine off (lifetime) (kilometres);
- (f) Total distance travelled in ~~charge~~-**charge**-depleting operation with engine running (lifetime) (kilometres);
- (g) Total distance travelled in driver-selectable ~~charge~~-**charge**-increasing operation (lifetime) (kilometres);
- (h) Engine fuel rate (grams/second);
- (i) Engine fuel rate (litres/hour);
- (j) Vehicle fuel rate (grams/second);
- (k) Vehicle speed (kilometres/hour);
- (l) Total grid energy into the battery (lifetime) (kWh)."

Appendix 5, paragraph 4.1., add a full stop after the referenced paragraph number 3 to read:

"4.1. With regard to the information specified in paragraph 3., the manufacturer shall ensure that the OBFCM device provides the most accurate values that can be achieved by the measurement and calculation system of the engine control unit."

Appendix 5, paragraph 4.2., add a full stop after the referenced paragraph numbers 4.1. 1.2. and 6. and replace the long dash with a minus sign to read:

"4.2. Notwithstanding paragraph 4.1., the manufacturer shall ensure that the accuracy is higher than— - 0.05 and lower than 0.05 calculated with three decimals using the following formula:

$$\text{Accuracy} = \frac{\text{Fuel_Consumed}_{\text{WLTP}} - \text{Fuel_Consumed}_{\text{OBFCM}}}{\text{Fuel_Consumed}_{\text{WLTP}}}$$

Where:

Fuel_Consumed_{WLTP} (litres) is the fuel consumption determined at the first test carried out in accordance with paragraph 1.2. of Annex B6, calculated in accordance with paragraph 6. of Annex B7, using emission results over the total cycle before applying corrections (output of step 2 in Table A7/1 of Annex B7), multiplied by the actual distance driven and divided by 100.

Fuel_Consumed_{OBFCM} (litres) is the fuel consumption determined for the same test using the differentials of the parameter 'Total fuel consumed (lifetime)' as provided by the OBFCM device.

For OVC-HEVs the charge-sustaining Type 1 test shall be used."

Appendix 5, paragraph 4.2.1., add a full stop **twice** after the referenced paragraph number 4.2. and replace the long dash with a minus sign to read:

"4.2.1. If the accuracy requirements set out in paragraph 4.2. are not met, the accuracy shall be recalculated for subsequent Type 1 tests performed in accordance with paragraph 1.2. of Annex B6, in accordance with the formulae in paragraph 4.2., using the fuel consumed determined and accumulated over all

performed tests. The accuracy requirement shall be deemed to be fulfilled once the accuracy is higher than— - 0.05 and lower than 0.05."

Appendix 5, paragraph 4.2.2., replace the long dash with a minus sign to read:

"4.2.2. If the accuracy requirements set out in paragraph 4.2.1. are not met following the subsequent tests pursuant to this point, additional tests may be performed for the purpose of determining the accuracy, however, the total number of tests shall not exceed three tests for a vehicle tested without using the interpolation method (vehicle H), and six tests for a vehicle tested using the interpolation method (three tests for vehicle H and three tests for vehicle L). The accuracy shall be recalculated for the additional subsequent Type 1 tests in accordance with the formulae in paragraph 4.2., using the fuel consumed determined and accumulated over all performed tests. The requirement shall be deemed to be fulfilled once the accuracy is higher than— - 0.05 and lower than 0.05. Where the tests have been performed only for the purpose of determining the accuracy of the OBFCM device, the results of the additional tests shall not be taken into account for any other purposes."

Appendix 5, paragraph 5.2., add a full stop after the referenced paragraph number 5.1. to read:

"5.2. By way of exemption from the reset conditions specified in the standards referred to in paragraph 5.1. and notwithstanding paragraphs 5.3. and 5.4., once the vehicle has entered into service the values of the lifetime counters shall be preserved."

Appendix 6, paragraph 5.4., remove the comma after the word operation to read:

"5.4. A deviation of more than 50 per cent between the average reagent consumption and the average demanded reagent consumption by the engine system over a period of 30 minutes of vehicle operation; shall result in the activation of the driver warning system in paragraph 3., which shall display a message indicating an appropriate warning (e.g. "urea dosing malfunction", "AdBlue dosing malfunction", or "reagent dosing malfunction"). If the reagent consumption is not rectified within 50 km of the activation of the warning system then the driver inducement requirements of paragraph 8. shall apply."

Amend the title of Annex A1, to read (text remains bold font):

"Engine and vehicle characteristics and information concerning the conduct of tests ('information document')"

Annex A1, amend row 0.2.3.12. and add rows 0.2.3.13. and 0.2.4. to read:

"

0.2.3.11.	Gas Fuelled Vehicle family(s): ...
0.2.3.12.	(Reserved)other family(s): ...
0.2.3.13.	K_{CO2} correction factor family: ...
0.2.4.	other family(s): ...
0.4.	Category of vehicle (c): ...

"

Annex A1, amend row 3.2.4.3.1. to read:

"

3.2.4.3.1.	Working principle: intake manifold (single-/multi-point/direct injection (†) /other (specify) (†): ...
------------	---

"

Annex A1, amend row 3.2.12.2.7.6.3. to read:

"

3.2.12.2.7.6.3.	<p>A comprehensive document describing all sensed components with the strategy for fault detection and MI activation (fixed number of driving cycles or statistical method), including a list of relevant secondary sensed parameters for each component monitored by the OBD system. A list of all OBD output codes and format used (with an explanation of each) associated with individual emission related power train powertrain components and individual non-emission related components, where monitoring of the component is used to determine MI activation, including in particular a comprehensive explanation for the data given in service \$05 Test ID \$21 to FF and the data given in service \$06.</p> <p>In the case of vehicle types that use a communication link in accordance with ISO 15765-4 ‘Road vehicles, diagnostics on controller area network (CAN) — Part 4: requirements for emissions-related systems’, a comprehensive explanation for the data given in service \$06 Test ID \$00 to FF, for each OBD monitor ID supported, shall be provided.</p>
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"

Annex A1, amend row 3.2.12.2.7.6.4.1. to read:

"

3.2.12.2.7.6.4.1.		Light-duty vehicles					
Component	Fault code	Monitoring strategy	Fault detection criteria	MI activation criteria	Secondary parameters	Preconditioning	Demonstration test
Catalyst	P0420	Oxygen sensor 1 and sensor 2 signals	Difference between sensor 1 and sensor 2 signals-	3rd cycle	Engine speed, engine load, A/F mode, catalyst temperature	Two Type 1 cycles	Type 1

"

Annex A1, amend rows 3.2.20.2.2. and 3.2.20.2.3. to read:

"

3.2.20.2.2.	Insulation nominal volume: ... (l) ^(x)
3.2.20.2.3.	Insulation nominal weight: ... (kg) ^(x)

"

Annex A1, amend rows 3.3.1. to read:

"

3.3.1.	General description of electric powertrain power train
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"

Annex A1, add new rows 3.3.2.10. to 3.3.2.11.3. to read:

"

3.3.2.9.	REESS position:.....
----------	----------------------

3.3.2.10.	Type of coolant : air/liquid ⁽¹⁾
3.3.2.11.	Battery management system control unit
3.3.2.11.1.	Make:
3.3.2.11.2.	Type:
3.3.2.11.3.	Identification number:
3.3.3.	Electric Motor

"

Annex A1, add new row 3.3.4.2.1. to read:

"

3.3.4.2.	Type :
3.3.4.2.1.	Identification number:
3.3.4.3.	Control principle: vectorial/open loop/closed/other (to be specified): (1)

"

Annex A1, add new rows 3.3.10. to 3.3.10.3.3. to read:

"

3.3.9.5.	Theoretical duration of a complete charge:
3.3.10.	Electric energy converters
3.3.10.1	Electric energy converter between the electric machine and traction REESS
3.3.10.1.1	Make :
3.3.10.1.2	Type :
3.3.10.1.3	Declared nominal power : W
3.3.10.2	Electric energy converter between the traction REESS and low voltage power supply
3.3.10.2.1	Make :
3.3.10.2.2	Type :
3.3.10.2.3	Declared nominal power : W
3.3.10.3	Electric energy converter between the recharge-plug-in and traction REESS
3.3.10.3.1	Make :
3.3.10.3.2	Type :
3.3.10.3.3	Declared nominal power : W
3.4.	Combinations of propulsion energy converters

"

Annex A1, add new rows 3.4.4.7. to 3.4.4.8.3. to read:

"

3.4.4.6.	Charger: on board/external/without ⁽¹⁾
3.4.4.7.	Type of coolant : air/liquid ⁽¹⁾
3.4.4.8.	Battery management system control unit
3.4.4.8.1.	Make:
3.4.4.8.2.	Type:
3.4.4.8.3.	Identification number:
3.4.5.	Electric machine (describe each type of electric machine separately)

"

Annex A1, add new rows 3.4.5.6. to 3.4.5.6.3.4. to read:

"

3.4.5.5.3.	Synchronous/asynchronous ⁽¹⁾
3.4.5.6.	Cooling system: Motor: liquid/air (1) Controller: liquid/air (1)
3.4.5.6.1.	Liquid-cooling equipment characteristics:
3.4.5.6.1.1.	Nature of the liquid circulating pumps: yes/no (1)
3.4.5.6.1.2.	Characteristics or make(s) and type(s) of the pump:
3.4.5.6.1.3.	Thermostat: setting:
3.4.5.6.1.4.	Radiator: drawing(s) or make(s) and type(s):
3.4.5.6.1.5.	Relief valve: pressure setting:
3.4.5.6.1.6.	Fan: characteristics or make(s) and type(s):
3.4.5.6.1.7.	Fan duct:
3.4.5.6.2.	Air-cooling equipment characteristics
3.4.5.6.2.1.	Blower: characteristics or make(s) and type(s):
3.4.5.6.2.2.	Standard air ducting:
3.4.5.6.2.3.	Temperature regulating system: yes/no (1)
3.4.5.6.2.4.	Brief description:
3.4.5.6.2.5.	Air filter: make(s): type(s):
3.4.5.6.3.	Temperatures admitted by the manufacturer (maximum)
3.4.5.6.3.1.	Motor outlet: ° C
3.4.5.6.3.2.	controller inlet: ° C
3.4.5.6.3.3.	at motor reference point(s): ° C
3.4.5.6.3.4.	at controller reference point(s): ° C
3.4.6.	Control unit

"

Annex A1, add new rows 3.4.11. to 3.4.11.3.3. to read:

"

3.4.10.2.	System description (working principle of the fuel cell, drawing, etc.): ...
3.4.11.	Electric energy converters
3.4.11.1.	Electric energy converter between the electric machine and traction REESS
3.4.11.1.1.	Make :
3.4.11.1.2.	Type :
3.4.11.1.3.	Declared nominal power : W
3.4.11.2.	Electric energy converter between the traction REESS and low voltage power supply
3.4.11.2.1.	Make :
3.4.11.2.2.	Type :
3.4.11.2.3.	Declared nominal power : W
3.4.11.3.	Electric energy converter between the recharge-plug-in and traction REESS
3.4.11.3.1.	Make :
3.4.11.3.2.	Type :
3.4.11.3.3.	Declared nominal power : W
3.5.	Manufacturer's declared values for determination of CO ₂ emissions/fuel consumption/electric energy consumption/electric range

"

In Annex A1, amend rows 3.5.7.2. and 3.5.7.2.1. to read:

"

3.5.7.2.	Combined CO ₂ mass emissions
3.5.7.2.1.	CO ₂ mass emission for pure ICE vehicles and NOVC-HEVs

"

Annex A1, amend rows 3.5.7.2,2. to 3.5.7.2.3.3. to read:

"

3.5.7.2.2.	Charge-Sustaining CO ₂ mass emission for OVC-HEVs
3.5.7.2.2.1.	Charge -Charge-Sustaining CO ₂ mass emission vehicle high: g/km
3.5.7.2.2.2.	Charge -Charge-Sustaining CO ₂ mass emission vehicle low (if applicable): g/km
3.5.7.2.2.3.	Charge -Charge-Sustaining CO ₂ mass emission vehicle M (if applicable): g/km
3.5.7.2.3.	Charge -Charge-Depleting CO ₂ mass emission and weighted CO ₂ mass emission for OVC-HEVs
3.5.7.2.3.1.	Charge -Charge-Depleting CO ₂ mass emission of Vehicle high: ... g/km

3.5.7.2.3.2.	Charge Charge-Depleting CO₂ mass emission of Vehicle low (if applicable): ... g/km
3.5.7.2.3.3.	Charge Charge-Depleting CO₂ mass emission of Vehicle M (if applicable): ... g/km

"

Annex A1, amend row 3.5.7.4.1. to read:

"

3.5.7.4.1.	Charge Charge-Sustaining fuel consumption for NOVC-FCHVs and OVC-FCHVs (as applicable)
------------	--

"

In Annex A1, amend row 3.5.7.4.2. to read:

"

3.5.7.4.2.	Charge Charge-Depleting fuel consumption for OVC-FCHVs (as applicable)
------------	--

"

Annex A1, add new rows 3.5.7.6. to 3.5.7.6.4.3. to read:

"

3.5.7.5.2.3.	Vehicle M (if applicable): ... Wh/km
3.5.7.6.	Fuel efficiency
3.5.7.6.1.	Fuel efficiency for pure ICE vehicles and NOVC-HEVs
3.5.7.6.1.1.	Vehicle high: ... km/l
3.5.7.6.1.2.	Vehicle low (if applicable): ... km/l
3.5.7.6.1.3.	Vehicle M (if applicable): ... km/l
3.5.7.6.2.	Charge-Sustaining fuel efficiency for OVC-HEVs
3.5.7.6.2.1.	Charge-Sustaining fuel efficiency vehicle high: km/l
3.5.7.6.2.2.	Charge-Sustaining fuel efficiency vehicle low (if applicable): km/l
3.5.7.6.2.3.	Charge-Sustaining fuel efficiency vehicle M (if applicable): km/l
3.5.7.6.3.	Charge-Depleting fuel efficiency for OVC-HEVs
3.5.7.6.3.1.	Charge-Depleting fuel efficiency of Vehicle high: ... km/l
3.5.7.6.3.2.	Charge-Depleting fuel efficiency of Vehicle low (if applicable): ... km/l
3.5.7.6.3.3.	Charge-Depleting fuel efficiency of Vehicle M (if applicable): ... km/l
3.5.7.6.4.	Fuel efficiency for NOVC-FCHV
3.5.7.6.4.1.	Vehicle high: ... km/kg
3.5.7.6.4.2.	Vehicle low (if applicable): ... km/kg
3.5.7.6.4.3.	Vehicle M (if applicable): ... km/kg
3.6.	Temperatures permitted by the manufacturer

"

Annex AI, amend row 12.10.1. to read:

"

12.10.1.	Charge Charge -sustaining test (if applicable) (state for each device or system)
----------	--

"

Annex AI, amend row 12.10.2. to read:

"

12.10.2.	Charge Charge -depleting test (if applicable) (state for each device or system)
----------	---

"

Annex AI, amend the explanatory notes (x) and (c) to read:

"Explanatory notes

- (¹) Delete where not applicable (there are cases where nothing needs to be deleted when more than one entry is applicable).
- (²) Specify the tolerance.
- (³) Please fill in here the upper and lower values for each variant.
- (⁶) [Reserved]
- (⁷) Optional equipment that affects the dimensions of the vehicle shall be specified.
- (^x) For insulation **nominal** volume and insulation **nominal** weight, state to 2 decimal places. Not to be documented if "no" in paragraph 3.2.20.2.5. or 3.2.20.2.7. **A tolerance of +/- 10 per cent shall be applied for insulation volume and insulation weight.**
- (^c) As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.6, ~~paragraph- 2.~~ - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html.
- (^f) Where there is one version "

Annex AI, Appendix I, amend the introductory text to read (previous bold text remains bold):

"Test Reports

A Test Report is the report issued by the technical service responsible for conducting the tests according this ~~R~~regulation.

Part I

The following information, if applicable, is the minimum data required for the Type 1 test.

Report number

APPLICANT		
Manufacturer		
SUBJECT ...		
Roadload family identifier(s)	:	
Interpolation family identifier(s)	:	
Object submitted to tests		
	Make	:
	IP identifier	:
CONCLUSION	The object submitted to tests complies with the requirements mentioned in the subject.	

PLACE,	DD/MM/YYYY
--------	------------

General notes:

If there are several options (references), the one tested should be described in the test report

If there are not, a single reference to the information document at the start of the test report may be sufficient.

Every Technical Service is free to include some additional information.

~~Test results may/shall be repeated to handle 3 phase and 4 phase WLTP.~~

Characters are included in the sections of the test report relating to specific vehicle types, as follows:

"(a)" Specific to positive ignition engine vehicles or vehicles 'G' (as specified in Table 1B of UN **Regulation No. 154**~~{xxx}~~) (as applicable).

"(b)" Specific to compression ignition engine vehicles or vehicles 'D' (as specified in Table 1B of UN **Regulation No. 154**~~{xxx}~~) (as applicable)."

Annex A1, Appendix 1, paragraph 1.1.2., amend and add a footnote to read:

1.1.2. Internal Combustion Engine (if applicable)

For more than one ICE, please repeat the point

Make	:	
Type	:	
Working principle	:	two/four stroke
Cylinders number and arrangement	:	
Engine capacity (cm ³)	:	
Engine idling speed (min ⁻¹)	:	+ -
High engine idling speed (min ⁻¹) (a)	:	+ -
Rated engine power	:	kW at rpm
Maximum net torque	:	Nm at rpm
Engine lubricant	:	make and type
Cooling system	:	Type: air/water/oil
Insulation	:	material, amount, location, nominal volume and nominal weight ⁽⁴⁾

⁽⁴⁾ a tolerance of +/- 10 per cent is permitted for volume and weight

Annex A1, Appendix 1, paragraph 1.1.8., amend the footnote to read:

1.1.8. Transmission (if applicable)

For more than one Transmission, please repeat the point

Gearbox	:	manual / automatic / continuous variation
Gear shifting procedure		
Predominant mode*	:	yes/no normal / drive / eco/...
Best case mode for CO ₂ emissions and fuel consumption (if applicable)	:	
Worst case mode for CO ₂ emissions and fuel consumption (if applicable)	:	
Highest electric energy consumption mode (if applicable)	:	
Control unit	:	
Gearbox lubricant	:	make and type

Tyres		
Make	:	
Type	:	
Dimensions front/rear	:	
Dynamic circumference (m)	:	
Tyre pressure (kPa)	:	

* for OVC-HEV, specify for ~~charge-charge~~-sustaining and for ~~charge-charge~~-depleting operating conditions.

Transmission ratios (R.T.), primary ratios (R.P.) and (vehicle speed (km/h)) / (engine speed (1000 (min⁻¹)) (V₁₀₀₀)) for each of the gearbox ratios (R.B.).

R.B.	R.P.	R.T.	V ₁₀₀₀
1st	1/1		
2nd	1/1		
3rd	1/1		
4th	1/1		
5th	1/1		
...			

"

Annex A1, Appendix 1, paragraph 1.2.2., amend to read:

"1.2.2. Road load parameters

f ₀ (N)	:	
f ₁ (N/(km/h))	:	
f ₂ (N/(km/h) ²)	:	
Cycle energy demand 4 phase cycle (J)	:	
Cycle energy demand 3 phase cycle (J)	:	
Road load test report reference	:	
Road load family's identifier	:	

"

Annex A1, Appendix 1, paragraph 1.3., amend to read:

"1.3. Vehicle low description (if APPLieableapplicable) "

Annex A1, Appendix 1, paragraph 1.3.2., amend to read:

"1.3.2. Road load parameters

f_0 (N)	:	
f_1 (N/(km/h))	:	
f_2 (N/(km/h) ²)	:	
Cycle energy demand 4 phase cycle (J)	:	
Cycle energy demand 3 phase cycle (J)	:	
$\Delta(C_D \times A_f)_{LH}$ (m ²)	:	
Road load test report reference	:	
Road load family's identifier	:	

"

Annex A1, Appendix 1, paragraph 1.4., amend to read:

"1.4. Vehicle M description (if applicable)"

Annex A1, Appendix 1, paragraph 1.4.2., amend to read:

"1.4.2. Road load parameters

f_0 (N)	:	
f_1 (N/(km/h))	:	
f_2 (N/(km/h) ²)	:	
Cycle energy demand 4 phase cycle (J)	:	
Cycle energy demand 3 phase cycle (J)	:	
$\Delta(C_D \times A_f)_{LH}$ (m ²)	:	
Road load test report reference	:	
Road load family's identifier	:	

"

Annex A1, Appendix 1, paragraph 2.1.1., amend to read:

"2.1.1. Vehicle high

Date(s) of test(s)	:	(day/month/year)
Place of the test(s)	:	Chassis dyno, location, country
Height of the lower edge above ground of cooling fan (cm)	:	
Lateral position of fan centre (if modified as request by the manufacturer)	:	in the vehicle centre-line/...
Distance from the front of the vehicle (cm)	:	
IWR: Inertial Work Rating 4 phase cycle (%)	:	x.x
IWR: Inertial Work Rating 3 phase cycle (%)	:	x.x
RMSSE: Root Mean Squared Speed Error 4 phase cycle (km/h)	:	x.xx
RMSSE: Root Mean Squared Speed Error 3 phase cycle (km/h)	:	x.xx
Description of the accepted deviation of the driving cycle	:	PEV before break off criteria or Fully operated acceleration pedal

"

Annex A1, Appendix 1, paragraph 2.1.1.1., move the comma from after the word case to after the word mode in the text before the table to read:

"2.1.1.1.1. Pollutant emissions of vehicles with at least one combustion engine, of NOVC-HEVs and of OVC-HEVs in case of a charge-sustaining Type 1 test

For each driver selectable mode tested the points below shall be repeated (predominant mode or best case mode and worst case, mode, if applicable)

Test 1a – Results after 4 Phase cycle

<i>Pollutants</i>	<i>CO</i> <i>(mg/km)</i>	<i>THC (a)</i> <i>(mg/km)</i>	<i>NMHC (a)</i> <i>(mg/km)</i>	<i>NO_x</i> <i>(mg/km)</i>	<i>THC+NO_x</i> <i>(b)</i> <i>(mg/km)</i>	<i>Particulate Matter</i> <i>(mg/km)</i>	<i>Particle Number</i> <i>(#.10¹¹/km)</i>
Measured values							
Regeneration factors (Ki) ⁽²⁾ Additive							
Regeneration factors (Ki) ⁽²⁾ Multiplicative							
Deterioration factors (DF) additive							
Deterioration factors (DF) multiplicative							
Final values							
Limit values							

Test 1b – Results after 3 Phase cycle

<i>Pollutants</i>	<i>CO</i> <i>(mg/km)</i>	<i>THC (a)</i> <i>(mg/km)</i>	<i>NMHC (a)</i> <i>(mg/km)</i>	<i>NO_x</i> <i>(mg/km)</i>	<i>Particulate Matter</i> <i>(mg/km)</i>	<i>Particle Number</i> <i>(#.10¹¹/km)</i>
Measured values						
Regeneration factors (Ki) ⁽²⁾ Additive						
Regeneration factors (Ki) ⁽²⁾ Multiplicative						
Deterioration factors (DF) additive						
Deterioration factors (DF) multiplicative						
Final values						
Limit values		-				

⁽²⁾ See Ki family report(s)	:	
Type 1 performed for Ki determination	:	
Regeneration family's identifier	:	

Tests 2a and 2b if applicable: for CO₂ reason (d_{CO₂¹) / for pollutants reason (90% of the limits) / for both Record test results in accordance with the table of Test 1}

Tests 3 a and 3b if applicable: for CO₂ reason (d<sub>CO₂²)
Record test results in accordance with the table of Test 1"</sub>

Annex A1, Appendix 1, paragraph 2.1.1.1.2., amend to read:

"2.1.1.1.2. Pollutant emissions of OVC-HEVs in case of a charge-depleting type 1 test**Test 1a – Results after 4 Phase cycle**

Pollutant emission limits have to be fulfilled and the following point has to be repeated for each driven test cycle.

<i>Pollutants</i>	<i>CO</i> (mg/km)	<i>THC (a)</i> (mg/km)	<i>NMHC (a)</i> (mg/km)	<i>NO_x</i> (mg/km)	<i>THC+NO_x (b)</i> (mg/km)	<i>Particulate Matter</i> (mg/km)	<i>Particle Number</i> (#.10 ¹¹ /km)
Measured single cycle values							
Limit single cycle values							

Test 21b – Results after 3 Phase cycle

Pollutant emission limits have to be fulfilled and the following point has to be repeated for each driven test cycle.

<i>Pollutants</i>	<i>CO</i> (mg/km)	<i>THC (a)</i> (mg/km)	<i>NMHC (a)</i> (mg/km)	<i>NO_x</i> (mg/km)	<i>Particulate Matter</i> (mg/km)	<i>Particle Number</i> (#.10 ¹¹ /km)
Measured single cycle values						
Limit single cycle values						

Tests 2a and 2b (if applicable): for CO₂ reason (d_{CO₂¹) / for pollutants reason (90% of the limits) / for both}

Record test results in accordance with the table of Test 1

Tests 3a and 3b (if applicable): for CO₂ reason (d_{CO₂²)}

Record test results in accordance with the table of Test 1"

Annex A1, Appendix 1, paragraph 2.1.1.1.3., amend to read:

"2.1.1.1.3. UF-weighted pollutant emissions of OVC-HEVS

<i>Pollutants</i>	<i>CO</i> (mg/km)	<i>THC (a)</i> (mg/km)	<i>NMHC (a)</i> (mg/km)	<i>NO_x</i> (mg/km)	<i>THC+NO_x (b)</i> (mg/km)	<i>Particulate Matter</i> (mg/km)	<i>Particle Number</i> (#.10 ¹¹ /km)
Calculated values 4 phase cycle							

"

Annex A1, Appendix 1, paragraph 2.1.1.2.1., move the comma from after the word case to after the word mode in the text before the table, delete the dash from the right column of the first row of table test 1 and amend the text and tables to read:

"2.1.1.2.1. CO₂ emission of vehicles with at least one combustion engine, of NOVC-HEV and of OVC-HEV in the case of a charge-sustaining Type 1 test

For each driver selectable mode tested the points below have to be repeated (predominant mode or best case mode and worst case₇ mode, if applicable)

Test 1a – Results after 4 Phase cycle

<i>CO₂ emission</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>Combined</i>
Measured value M _{CO₂,p,1} / M _{CO₂,e,2}					-
Speed and distance corrected value M _{CO₂,p,+2b} / M _{CO₂,e,2b}					
RCB correction coefficient: ⁽⁵⁾					

<i>CO₂ emission</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>Combined</i>
$M_{CO_2,p,3} / M_{CO_2,c,3}$					
Regeneration factors (Ki) Additive					
Regeneration factors (Ki) Multiplicative					
$M_{CO_2,c,4}$			-		
$AF_{Ki} = M_{CO_2,c,3} / M_{CO_2,c,4}$			-		
$M_{CO_2,p,4} / M_{CO_2,c,4}$					-
ATCT correction (FCF) ⁽⁴⁾					
Temporary values $M_{CO_2,p,5} / M_{CO_2,c,5}$					
Declared value	-	-	-	-	
dc_{CO₂}¹ * declared value	-	-	-	-	

⁽⁴⁾ FCF: family correction factor for correcting for representative regional temperature conditions (ATCT)

See ATCT family report(s)	:	
ATCT family's identifier	:	

⁽⁵⁾ correction as referred to in Appendix 2 to Annex B6 of UN Regulation **No. 154** for pure ICE vehicles, and Appendix 2 to Annex B8 of UN Regulation **No. 154** for HEVs (K_{CO₂})

Tests **2a** and **2b** (if applicable)

Record test results in accordance with the table of Test 1

Tests **3a** and **3b** (if applicable)

Record test results in accordance with the table of Test 1

Conclusion

Conclusion after 4 Phase cycle <i>CO₂ emission (g/km)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>		<i>Extra High</i>	<i>Combined</i>
Averaging $M_{CO_2,p,6} / M_{CO_2,c,6}$						
Alignment $M_{CO_2,p,7} / M_{CO_2,c,7}$						
Final values $M_{CO_2,p,H} / M_{CO_2,c,H}$						

"

Annex A1, Appendix 1, paragraph 2.1.1.2.2., amend to read:

"2.1.1.2.2. CO₂ mass emission of OVC-HEVs in case of a charge-depleting Type 1 test

Test 1

<i>CO₂ mass emission (g/km)</i>	<i>Combined</i> <i>4 phase cycle</i>
Calculated value $M_{CO_2,CD}$	
Declared value	
dc_{CO₂}¹	

Test 2 (if applicable)

Record test results in accordance with the table of Test 1

Test 3 (if applicable)

Record test results in accordance with the table of Test 1

Conclusion

<i>CO₂ mass emission (g/km)</i>	<i>Combined 4 phase cycle</i>
Averaging M _{CO₂,CD}	
Final value M_{CO₂,CD}	

"

Annex A1, Appendix 1, renumber paragraph 2.1.1.2.4. to 2.1.1.2.3. and amend to read (title remains bold font):

"2.1.1.2.43. UF-weighted CO₂ mass emission of OVC-HEVS

<i>CO₂ mass emission (g/km)</i>	<i>Combined 4 phase cycle</i>
Calculated value M _{CO₂,weighted}	

"

Annex A1, Appendix 1, paragraph 2.1.1.3.1., amend to read (title remains bold font):

"2.1.1.3.1. Fuel consumption of vehicles with only a combustion engine, of NOVC-HEVs and of OVC-HEVs in case of a charge-sustaining Type 1 test

For each driver selectable mode tested the points below has to be repeated (predominant mode or best case mode and worst case, mode if applicable)

<i>Fuel consumption (l/100 km) or fuel efficiency (km/l) (as applicable)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>Combined FC</i>	<i>Combined FE</i>
Final values FC _{p,H} / FC _{c,H} ⁽⁶⁾ , FE_p FE_c						-
Final values FE_p, FE_c					-	

⁽⁶⁾ Calculated from aligned CO₂ values

On-board Fuel and/or Energy Consumption Monitoring for vehicles referred to in paragraph 5.11. of this Regulation

Data accessibility

The parameters listed in paragraph 3 of Appendix 5 to this Regulation are accessible: yes/not applicable Accuracy (if applicable)

Fuel_ConsumedWLTP (litres) ⁽⁸⁾	Vehicle HIGH - Test 1	x.xxx
	Vehicle HIGH - Test 2 (if applicable)	x.xxx
	Vehicle HIGH - Test 3 (if applicable)	x.xxx
	Vehicle LOW - Test 1 (if applicable)	x.xxx
	Vehicle LOW Test 2 (if applicable)	x.xxx
	Vehicle LOW - Test 3 (if applicable)	x.xxx
	Total	x.xxx
Fuel_ConsumedOBFCM (litres) ⁽⁸⁾	Vehicle HIGH - Test 1	x.xxx ⁽⁹⁾
	Vehicle HIGH - Test 2 (if applicable)	x.xxx ⁽⁹⁾
	Vehicle HIGH - Test 3 (if applicable)	x.xxx ⁽⁹⁾
	Vehicle LOW - Test 1 (if applicable)	x.xxx ⁽⁹⁾
	Vehicle LOW Test 2 (if applicable)	x.xxx ⁽⁹⁾
	Vehicle LOW - Test 3 (if applicable)	x.xxx ⁽⁹⁾

	Total	x.xxx ⁽⁹⁾
Accuracy ⁽⁸⁾		x.xxx

⁽⁸⁾ in accordance with Appendix 5 to this Regulation

⁽⁹⁾ in the case that the OBFCEM signal can only be read-out to 2 decimal places, the third decimal place shall be introduced as a zero"

Annex A1, Appendix 1, paragraph 2.1.1.3.2., amend to read:

"2.1.1.3.2. Fuel consumption of OVC-HEVs and OVC-FCHVs (as applicable) in case of a charge-depleting Type 1 test

Test 1:

<i>Fuel consumption (l/100 km or kg/100 km) or fuel efficiency (km/l) (as applicable)</i>	Fuel consumption (l/100 km or kg/100 km) Combined 4 phase cycle	Fuel efficiency (km/l) Combined 3 phase cycle
Calculated value FC _{CD} , FE _{CD}		

Test 2 (if applicable)

Record test results in accordance with the table of Test 1

Test 3 (if applicable)

Record test results in accordance with the table of Test 1

Conclusion

<i>Fuel consumption (l/100km or kg/100 km) or fuel efficiency (km/l) (as applicable)</i>	Fuel consumption (l/100 km or kg/100 km) Combined 4 phase cycle	Fuel efficiency (km/l) Combined 3 phase cycle
Averaging FC _{CD} , FE _{CD}		
Final value FC _{CD} , FE _{CD}		

"

Annex A1, Appendix 1, paragraph 2.1.1.3.3., amend to read:

"2.1.1.3.3. UF-Weighted Fuel consumption of OVC-HEVs and OVC-FCHVs (as applicable)

<i>Fuel consumption (l/100 km or kg/100 km) or fuel efficiency (km/l) (as applicable)</i>	Fuel consumption (l/100 km or kg/100 km) Combined 4 phase cycle
Calculated value FC _{weighted} , FE _{weighted}	

"

Annex A1, Appendix 1, paragraph 2.1.1.3.4., amend to read:

"2.1.1.3.4. Fuel consumption of vehicles of NOVC-FCHVs and OVC-FCHVs (as applicable) in case of a charge-sustaining Type 1 test

For each driver selectable mode tested the points below has to be repeated (predominant mode or best case mode and worst case, mode if applicable)

<i>Fuel consumption (kg/100 km) or fuel efficiency (km/kg) (as applicable)</i>	<i>Fuel consumption (l/100 km or kg/100 km) Combined 4 phase cycle</i>	<i>Fuel efficiency (km/l) Combined 3 phase cycle</i>
Measured values		
RCB correction coefficient		
Final values FC _c , FE _c		

"

Annex A1, Appendix 1, paragraph 2.1.1.4.1.1., amend to read:

"2.1.1.4.1.1. All electric range

Test 1

<i>AER (km)</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Measured/Calculated values AER			
Declared value	-		

Test 2 (if applicable)

Record test results in accordance with the table of Test 1

Test 3 (if applicable)

Record test results in accordance with the table of Test 1

Conclusion

<i>AER (km)</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Averaging AER (if applicable)			
Final values AER			

"

Annex A1, Appendix 1, paragraph 2.1.1.4.1.2., amend to read:

"2.1.1.4.1.2. Equivalent All electric Range

<i>EAER (km)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Final values EAER							

"

Annex A1, Appendix 1, paragraph 2.1.1.4.1.3., amend to read:

"2.1.1.4.1.3. Actual Charge-Depleting Range

<i>RCDA (km)</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Final value RCDA		

"

Annex A1, Appendix 1, paragraph 2.1.1.4.1.4., amend to read:

"2.1.1.4.1.4. Charge-Depleting Cycle Range

Test 1

<i>RDCD (km)</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Final value R _{CDC}		
Index Number of the transition cycle		
REEC of confirmation-cycle (%)		

Test 2 (if applicable)

Record test results in accordance with the table of Test 1

Test 3 (if applicable)

Record test results in accordance with the table of Test 1"

Annex A1, Appendix 1, paragraph 2.1.1.4.2., amend to read:

"2.1.1.4.2. Ranges for PEVs - Pure electric range (if applicable)

Test 1

<i>PER (km)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Calculated values PER							
Declared value	-	-	-	-	-		

Test 2 (if applicable)

Record test results in accordance with the table of Test 1

Test 3 (if applicable)

Record test results in accordance with the table of Test 1

Conclusion

<i>PER (km)</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Averaging PER			
Final values PER			

"

Annex A1, Appendix 1, paragraph 2.1.1.5.1.2., amend to read:

"2.1.1.5.1.2. Electric energy consumption (EC)

<i>EC (Wh/km)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Final values EC							

"

Annex A1, Appendix 1, paragraph 2.1.1.5.1.3., amend to read:

"2.1.1.5.1.3. UF-weighted charge-depleting electric energy consumption

Test 1

<i>EC_{AC,CD} (Wh/km)</i>	<i>Combined 4 phase cycle</i>
Calculated value EC _{AC,CD}	

Test 2 (if applicable)

Record test results in accordance with the table of Test 1

Test 3 (if applicable)

Record test results in accordance with the table of Test 1

Conclusion (if applicable)

$EC_{AC,CD}$ (Wh/km)	<i>Combined 4 phase cycle</i>
Averaging $EC_{AC,CD}$	
Final value	

"

Annex A1, Appendix 1, paragraph 2.1.1.5.1.4., amend to read:

"2.1.1.5.1.4. UF-weighted electric energy consumption

Test 1

$EC_{AC,weighted}$ (Wh)	<i>Combined 4 phase cycle</i>
Calculated value $EC_{AC,weighted}$	

Test 2 (if applicable)

Record test results in accordance with the table of Test 1

Test 3 (if applicable)

Record test results in accordance with the table of Test 1

Conclusion (if applicable)

$EC_{AC,weighted}$ (Wh/km)	<i>Combined 4 phase cycle</i>
Averaging $EC_{AC,weighted}$	
Final value	

"

Annex A1, Appendix 1, paragraph 2.1.1.5.1.5., amend to read:

"2.1.1.5.1.5. Information for COP

	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Electric energy consumption (Wh/km) $EC_{DC,CD,COP}$		
$AF_{EC,AC,CD}$		

"

Annex A1, Appendix 1, paragraph 2.1.1.5.2., amend to read:

"**2.1.1.5.2. Electric energy consumption of PEVs (if applicable)**

Test 1

E_{AC} (Wh)	
---------------	--

EC (Wh/km)	City	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
--------------	------	-----------------------------------	-----------------------------------

Calculated values EC			
Declared value	-		

Test 2 (if applicable)

Record test results in accordance with the table of Test 1

Test 3 (if applicable)

Record test results in accordance with the table of Test 1

<i>EC (Wh/km)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Averaging EC							
Final values EC							

Information for COP

	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Electric Energy Consumption (Wh/km) EC _{DC,COP}		
AF _{EC}		

"

Annex A1, Appendix 1, paragraph 2.1.4., amend to read:

2.1.4. Final criteria emissions values (if applicable)

<i>Pollutants</i>	<i>CO</i> <i>(mg/km)</i>	<i>THC (a)</i> <i>(mg/km)</i>	<i>NMHC (a)</i> <i>(mg/km)</i>	<i>NOx</i> <i>(mg/km)</i>	<i>THC+NOx (b)</i> <i>(mg/km)</i>	<i>PM</i> <i>(mg/km)</i>	<i>PN</i> <i>(#.1011/km)</i>
Highest values⁽³⁾ 4 phase test							

⁽³⁾ for each pollutant within all test results of VH, VL (if applicable) and VM (if applicable)"

Annex A1, Appendix 1, Part II, amend the general notes of the introduction to read:

"General notes:

If there are several options (references), the one tested should be described in the test report

If there are not, a single reference to the information document at the start of the test report may be sufficient.

Every Technical Service is free to include some additional information.

Characters are included in the sections of the test report relating to specific vehicle types, as follows:

“(a)” Specific to positive ignition engine vehicles or vehicles ‘G’ (as specified in Table 1B of UN Regulation No. 154 [xxx]) (as applicable).

“(b)” Specific to compression ignition engine vehicles or vehicles ‘D’ (as specified in Table 1B of UN Regulation No. 154 [xxx]) (as applicable). "

Annex A1, Appendix 1, Part II, paragraph 1.1.2., amend the last row of the table and add a footnote to read:

1.1.2. Internal combustion engine (if applicable)

For more than one ICE, please repeat the point

Make	:				
Type	:				
Working principle	:	two/four stroke			
Cylinders number and arrangement	:				
Engine capacity (cm ³)	:				
Engine idling speed (min ⁻¹)	:		±		
High engine idling speed (min ⁻¹) (a)	:		±		
Rated engine power	:		kW	At	rpm
Maximum net torque	:		Nm	At	rpm
Engine lubricant	:	make and type			
Cooling system	:	Type: air/water/oil			
Insulation	:	material, amount, location, nominal volume and nominal weight ⁽⁴⁾			

⁽⁴⁾ a tolerance of +/- 10 per cent is permitted for volume and weight"

Annex A1, Appendix 1, Part II, paragraph 1.2.2., amend to read:

"1.2.2. Road load parameters

f_0 (N)	:	
f_1 (N/(km/h))	:	
f_2 (N/(km/h) ²)	:	
f_{2_TReg} (N/(km/h) ²)	:	
Cycle energy demand 4 phase cycle (J)	:	
Road load test report reference	:	
Road load family's identifier	:	

"

Annex A1, Appendix 1, Part II, paragraph 2.1., amend to read:

"2.1 Test at 14°C

Date(s) of test(s)	:	(day/month/year)
Place of the test(s)	:	
Height of the lower edge above ground of cooling fan (cm)	:	
Lateral position of fan centre (if modified as request by the manufacturer)	:	in the vehicle centre-line/...
Distance from the front of the vehicle (cm)	:	
IWR: Inertial Work Rating (%)	:	x.x
RMSSE: Root Mean Squared Speed Error (km/h)	:	x.xx
Description of the accepted deviation of the driving cycle	:	Fully operated acceleration pedal

"

Annex A1, Appendix 1, Part II, paragraph 2.1., amend to read (text remains bold):

"**2.1.1.** Pollutant emissions of vehicle with at least one combustion engine, of NOVC-HEVs and of OVC-HEVs in case of a charge-sustaining **test**

Pollutants	<i>CO</i> (mg/km)	<i>THC (a)</i> (mg/km)	<i>NMHC (a)</i> (mg/km)	<i>NO_x</i> (mg/km)	<i>THC+NO_x (b)</i> (mg/km)	<i>Particulate Matter</i> (mg/km)	<i>Particle Number</i> (#.10 ¹¹ /km)
Measured values							
Limit values							

"

Annex A1, Appendix 1, Part II, paragraph 2.1.2., amend the text before the table, delete the dash from the right column of the first row of table test 1 and amend the text of the first two rows of table test 1 to read:

"**2.1.2. CO₂ emission of vehicle with at least one combustion engine, of NOVC-HEV and of OVC-HEV in case of a charge-sustaining tests**

<i>CO₂ emission (g/km)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>Combined</i>
Measured value $M_{CO_2,p,1} / M_{CO_2,c,2}$					-
Measured Speed and distance corrected value $M_{CO_2,p,4+2b} / M_{CO_2,c,2b}$					
RCB correction coefficient ⁽²⁾					
$M_{CO_2,p,3} / M_{CO_2,c,3}$					

⁽²⁾ correction as referred to in Appendix 2 to Annex B6 of UN Regulation No. 154 for ICE vehicles, K_{CO_2} for HEVs"

Annex A1, Appendix 1, Part II, paragraph 2.2., insert a full stop after the paragraph number and amend the text in the table, to read (text remains bold):

"**2.2. Test at 23°C**

Provide information or refer to type 1 test report

Date of tests	:	(day/month/year)
Place of the test	:	
Height of the lower edge above ground of cooling fan (cm)	:	
Lateral position of fan centre (if modified as request by the manufacturer)	:	in the vehicle centre-line/...
Distance from the front of the vehicle (cm)	:	
IWR: Inertial Work Rating 4 phase cycle (%)	:	x.x
RMSSE: Root Mean Squared Speed Error 4 phase cycle (km/h)	:	x.xx
Description of the accepted deviation of the driving cycle	:	Fully operated acceleration pedal

"

Annex A1, Appendix 1, Part II, paragraph 2.2.1., amend the text before the table, to read (text remains bold):

"**2.2.1.** Pollutant emissions of vehicle with at least one combustion engine, of NOVC-HEVs and of OVC-HEVs in case of a charge-sustaining **test**"

Annex A1, Appendix 1, Part II, paragraph 2.2.2., amend the text before the table, delete the dash from the right column of the first row of table test 1 and amend the text of the first two rows of table test 1 to read:

"2.2.2. CO₂ emission of vehicle with at least one combustion engine, of NOVC-HEV and of OVC-HEV in case of a charge-sustaining tests"

CO ₂ emission (g/km)	Low	Medium	High	Extra High	Combined
Measured value M _{CO₂,p,1} / M _{CO₂,c,2}					-
Measured Speed and distance corrected value M _{CO₂,p,+b2b} / M _{CO₂,c,2b}					
RCB correction coefficient ⁽²⁾					
M _{CO₂,p,3} / M _{CO₂,c,3}					

⁽²⁾ correction as referred to in Appendix 2 to Annex B6 of this Regulation for ICE vehicles, and Appendix 2 to Annex B8 of this Regulation for HEVs (K_{CO₂})"

Annex A1, Appendix 2, paragraph 2.1.1., add a full stop after the paragraph numbering to read (previous bold text remains bold):

"2.1.1. General

	Wind tunnel		Dynamometer	
	H _R	L _R	H _R	L _R
Make				
Type				
Version				
Cycle energy demand over a complete WLTC Class 3 cycle (kJ)				
Deviation from production series	-	-		
Mileage (km)	-	-		

Or (in case of roadload matrix family):

Make	:	
Type	:	
Version	:	
Cycle energy demand over a complete WLTC (kJ)	:	
Deviation from production series	:	
Mileage (km)	:	

Annex A1, Appendix 2, paragraph 2.1.2., add a full stop after the paragraph numbering and amend the text in the second row of the second table to read (previous bold text remains bold):

"2.1.2. Masses

	Dynamometer	
	H _R	L _R
Test mass (kg)		
Average mass m _{av} (kg)		
Value of m _r (kg per axle)		
Category M vehicle: proportion of the vehicle mass in running order on the front axle (%)		
Category N vehicle: weight distribution (kg or %)		

Or (in case of roadload matrix family):

Test mass (kg)	:	
Average mass m_{av}(kg) m_{av} (kg)	:	(average before and after the test)
Technically permissible maximum laden mass	:	
Estimated arithmetic average of the mass of optional equipment	:	
Category M vehicle: proportion of the vehicle mass in running order on the front axle (%)	:	
Category N vehicle: weight distribution (kg or %)	:	

"

Annex A1, Appendix 2, paragraph 2.1.3., add a full stop after the paragraph numbering to read (previous bold text remains bold):

"2.1.3. Tyres

	Wind tunnel		Dynamometer	
	H _R	L _R	H _R	L _R
Size designation				
Make				
Type				
Rolling resistance				
Front (kg/t)	-	-		
Rear (kg/t)	-	-		
Tyre pressure				
Front (kPa)	-	-		
Rear (kPa)	-	-		

Or (in case of roadload matrix family):

Size designation		
Make	:	
Type	:	
Rolling resistance		
Front (kg/t)	:	
Rear (kg/t)	:	
Tyre pressure		
Front (kPa)	:	
Rear (kPa)	:	

"

Annex A1, Appendix 2, paragraph 2.1.4., amend the text in the second row of the second table to read (previous bold text remains bold):

"2.1.4. Bodywork

	Wind tunnel	
	H _R	L _R
Type	AA/AB/AC/AD/AE/AF BA/BB/BC/BD	
Version		
Aerodynamic devices		
Movable aerodynamic body parts	y/n and list if applicable	
Installed aerodynamic options list		
Delta (C _D × A _f) _{LH} compared to H _R (m ²)	-	

Or (in case of roadload matrix family):

Body shape description	:	Square box (if no representative body shape for a complete vehicle can be determined)
Frontal area A_f A _{fr} (m ²)	:	

"

Annex A1, Appendix 2, paragraph 2.2., add a full stop after the paragraph numbering and amend the text to read (text remains bold):

"2.2. ~~on~~ **On road**"

Annex A1, Appendix 2, paragraph 2.2.2., add a full stop after the paragraph numbering to read (previous bold text remains bold):

"2.2.2. Masses

	H _R	L _R
Test mass (kg)		
Average mass m _{av} (kg)		
Value of m _r (kg per axle)		
Category M vehicle: proportion of the vehicle mass in running order on the front axle (%)		
Category N vehicle: weight distribution (kg or %)		

Or (in case of roadload matrix family):

Test mass (kg)	:	
Average mass m _{av} (kg)	:	(average before and after the test)
Technically permissible maximum laden mass	:	
Estimated arithmetic average of the mass of optional equipment	:	
Category M vehicle: proportion of the vehicle mass in running order on the front axle (%)		
Category N vehicle: weight distribution (kg or %)		

"

Annex A1, Appendix 2, paragraph 2.2.3., add a full stop after the paragraph numbering to read (previous bold text remains bold):

"2.2.3. Tyres

	H _R	L _R
Size designation		
Make		
Type		
Rolling resistance		
Front (kg/t)		
Rear (kg/t)		
Tyre pressure		
Front (kPa)		
Rear (kPa)		

Or (in case of roadload matrix family):

Size designation	:	
Make	:	
Type	:	

Rolling resistance		
Front (kg/t)	:	
Rear (kg/t)	:	
Tyre pressure		
Front (kPa)	:	
Rear (kPa)	:	

Annex A1, Appendix 3, amend the rows Drive trace indices and Particulate sample filter weighing to read:

<p>Drive trace indices:</p> <p>The following indices shall be calculated in accordance with the standard SAE J2951(Revised Jan-2014):</p> <p>IWR : Inertial Work Rating 4 phase cycle</p> <p>IWR : Inertial Work Rating 3 phase cycle</p> <p>RMSSE : Root Mean Squared Speed Error 4 phase cycle</p> <p>RMSSE : Root Mean Squared Speed Error 3 phase cycle</p>	:	
<p>Particulate sample filter weighing</p> <p>Filter for phases 1-4 before the test where applicable</p> <p>Filter for phases 1-3 before the test where applicable</p> <p>Filter for phase 4 before the test where applicable</p> <p>Filter for phases 1-4 after the test where applicable</p> <p>Reference filter Filter for phases 1-3 after the test where applicable</p> <p>Filter for phase 4 after the test where applicable</p> <p>Reference filter</p>	:	

Annex A1, Appendix 4, add a new paragraph 2.3.6. to read (text before table is bold):

2.3.6. Demonstrated procedures for alternative conformity of production testing where applicable:

Test for leakage	:	Alternative pressures and/or time or alternative test procedure
Test for venting	:	Alternative pressure and/or time or alternative test procedure
Purge test	:	Alternative flow rate or test procedure
Sealed tank	:	Alternative test procedure

Annex A2, Communication, amend footnote 4 to read (text before table is bold):

⁴ As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.6, **paragraph 2.** - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html."

Annex A2, Addendum, paragraph 1.11., amend to read:

1.11. ~~Power train~~ **Powertrain** (for pure electric vehicle or hybrid electric vehicle) ^(a)"

Annex A2, Addendum, paragraph 2.1., amend to read:

"2.1. Tailpipe emissions test results

Emissions classification: ...

Type 1 test results, where applicable

Type approval number if not parent vehicle ⁽¹⁾: ...

Test 1a 4 phase test

<i>Type 1 Result</i>	<i>CO</i> (mg/km)	<i>THC</i> (mg/km)	<i>NMHC</i> (mg/km)	<i>NO_x</i> (mg/km)	<i>THC + NO_x</i> (mg/km)	<i>PM</i> (mg/km)	<i>PN</i> (#.10 ¹¹ /km)
Measured ⁽⁸⁾ ⁽⁹⁾							
Ki × ⁽⁸⁾ ⁽¹⁰⁾					⁽¹¹⁾		
Ki + ⁽⁸⁾ ⁽¹⁰⁾					⁽¹¹⁾		
Mean value calculated with Ki (M × Ki or M + Ki) ⁽⁹⁾					⁽¹²⁾		
DF (+) ⁽⁸⁾ ⁽¹⁰⁾							
DF (×) ⁽⁸⁾ ⁽¹⁰⁾							
Final mean value calculated with Ki and DF ⁽¹³⁾							
Limit value							

Test 1b 3 phase test

<i>Type 1 Result</i>	<i>CO</i> (mg/km)	<i>THC</i> (mg/km)	<i>NMHC</i> (mg/km)	<i>NO_x</i> (mg/km)	<i>PM</i> (mg/km)	<i>PN</i> (#.10 ¹¹ /km)
Measured ⁽⁸⁾ ⁽⁹⁾						
Ki × ⁽⁸⁾ ⁽¹⁰⁾						
Ki + ⁽⁸⁾ ⁽¹⁰⁾						
Mean value calculated with Ki (M × Ki or M + Ki) ⁽⁹⁾						
DF (+) ⁽⁸⁾ ⁽¹⁰⁾						
DF (×) ⁽⁸⁾ ⁽¹⁰⁾						
Final mean value calculated with Ki and DF ⁽¹³⁾						
Limit value						

Test 2a and 2b (if applicable)

Repeat Test 1a and 1b tables with the second test results.

Test 3a and 3b (if applicable)

Repeat Test 1 table with the third test results.

Repeat Test 1a and 1b, test 2a and 2b (if applicable) and test 3a and 3b (if applicable) for Vehicle Low (if applicable), and VM (if applicable)

ATCT test

<i>CO₂ Emission (g/km)</i>	<i>Combined</i>
ATCT (14 °C) M _{CO₂,Treg}	
Type 1 (23 °C) M _{CO₂,23°}	
Family correction factor (FCF)	

<i>ATCT test Result</i>	<i>CO (mg/km)</i>	<i>THC (mg/km)</i>	<i>NMHC (mg/km)</i>	<i>NO_x (mg/km)</i>	<i>THC + NO_x (mg/km)</i>	<i>PM (mg/km)</i>	<i>PN (#.10¹¹/km)</i>
Measured ^{1, 2}							
Limit values							

Difference between engine coolant end temperature and average soak area temperature of the last 3 hours ΔT_{ATCT} (°C) for the reference vehicle: ...

The minimum soaking time t_{soak_ATCT} (s): ...

Location of temperature sensor: ...

ATCT family identifier: ...

Type 4: ... g/test;

Test procedure in accordance with: Annex C3 to UN Regulation No. **154** [xxx] (1).

Type 5:

- (a) Durability test: whole vehicle test/bench ageing test/none (1)
- (b) Deterioration factor DF: calculated/assigned (1)
- (c) Specify the values: ...
- (d) Applicable Type 1 cycle (Annex B4 to UN Regulation No. **154** [xxx] (14): ..."

Annex A2, Addendum, paragraph 2.5.1.1.1., add new paragraphs 2.5.1.1.1.1. and 2.5.1.1.1.2., amend to read:

"2.5.1.1.1. Cycle Energy Demand: ... J

2.5.1.1.1.1. 4 phase cycle: ... J

2.5.1.1.1.2. 3 phase cycle: ... J"

Annex A2, Addendum, paragraph 2.5.1.1.3., amend to read:

"2.5.1.1.3. CO₂ mass emissions (provide values for each reference fuel tested, for the phases: the measured values, for the combined see **points paragraphs** 1.2.3.8. and 1.2.3.9. of Annex B6 to UN Regulation No. 154)

¹ Where applicable.

² Round to two decimal numbers.

<i>CO₂ Emission (g/km)</i>	<i>Test</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>Combined 4 phase cycle</i>
$M_{CO_2,p,5} / M_{CO_2,c,5}$	1					
	2					
	3					
	average					
Final $M_{CO_2,p,H} / M_{CO_2,c,H}$						

"

Annex A2, Addendum, paragraph 2.5.1.1.4., amend to read:

"2.5.1.1.4. Fuel consumption (provide values for each reference fuel tested, for the phases: the measured values for the combined see paragraphs 1.2.3.8 and 1.2.3.9 of Annex B6 to UN Regulation No. ~~154~~)

<i>Fuel consumption (l/100 km or m³/100 km or kg/100 km) ⁽¹⁾ or fuel efficiency (km/l or km/kg) ⁽¹⁾ (as applicable)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>Combined FC 4 phase cycle</i>	<i>Combined FE 3 phase cycle</i>
Final values $FC_{p,H}/FC_{c,H}$ or $FE_{p,H}, FE_{c,H}$						-
Final values $FE_{p,H}, FE_{c,H}$				-	-	

"

Annex A2, Addendum, paragraph 2.5.1.2.1., add new paragraphs 2.5.1.2.1.1. and 2.5.1.2.1.2., amend to read:

"2.5.1.2.1. Cycle Energy Demand:....J

2.5.1.2.1.1. 4 phase cycle:... J

2.5.1.2.1.2. 3 phase cycle:... J"

Annex A2, Addendum, paragraph 2.5.1.2.3., amend to read:

"2.5.1.2.3. CO₂ ~~mass~~ emissions (provide values for each reference fuel tested, for the phases: the measured values for the combined see ~~points~~ paragraphs 1.2.3.8. and 1.2.3.9. of Annex B6 to UN Regulation No. 154)

<i>CO₂ Emission (g/km)</i>	<i>Test</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>Combined 4 phase cycle</i>
$M_{CO_2,p,5}/M_{CO_2,c,5}$	1					
	2					
	3					
	average					
Final $M_{CO_2,p,L}/M_{CO_2,c,L}$						

"

Annex A2, Addendum, paragraph 2.5.1.2.4., amend to read (note: full stops added after the referenced paragraph numbers):

"2.5.1.2.4. Fuel consumption (provide values for each reference fuel tested, for the phases: the measured values for the combined see ~~points~~ paragraphs 1.2.3.8. and 1.2.3.9. of Annex B6 to UN Regulation No. 154)

Fuel consumption (l/100 km or m ³ /100 km or kg/100 km) ⁽¹⁾ or fuel efficiency (km/l or km/kg) ⁽¹⁾ (as applicable)	Low	Medium	High	Extra High	Combined FC 4 phase cycle	Combined FC 4 phase cycle
Final values FC _{p,L} /FC _{c,L} or FE_{p,L}, FE_{c,L}						-
Final values FE_{p,L}, FE_{c,L}				-	-	

"

Annex A2, Addendum, paragraph 2.5.1.3.1., add new paragraphs 2.5.1.2.1.1. and 2.5.1.2.1.2., amend to read:

"2.5.1.3.1. Cycle Energy Demand: ~~...~~ J

2.5.1.3.1.1. 4 phase cycle: ... J

2.5.1.3.1.2. 3 phase cycle: ... J"

Annex A2, Addendum, paragraph 2.5.1.3.3., amend to read (note: full stops added after the referenced paragraph numbers):

"2.5.1.3.3. CO₂ ~~mass~~ emissions (provide values for each reference fuel tested, for the phases: the measured values for the combined see paragraphs 1.2.3.8. and 1.2.3.9. of Annex B6 to UN Regulation No. 154)

CO ₂ Emission (g/km)	Test	Low	Medium	High	Extra High	Combined 4 phase cycle
M _{CO₂,p,5} /M _{CO₂,c,5}	1					
	2					
	3					
	average					
Final M _{CO₂,p,L} /M _{CO₂,c,L}						

"

Annex A2, Addendum, paragraph 2.5.1.3.4., amend to read:

"2.5.1.3.4. Fuel consumption (provide values for each reference fuel tested, for the phases: the measured values for the combined see paragraphs 1.2.3.8. and 1.2.3.9. of Annex B6 to UN Regulation No. **154** ~~[xxx]~~)

Fuel consumption (l/100 km or m ³ /100 km or kg/100 km) ⁽¹⁾ or fuel efficiency (km/l or km/kg) ⁽¹⁾ (as applicable)	Low	Medium	High	Extra High	Combined FC 4 phase cycle	Combined FE 3 phase cycle
Final values FC _{p,L} / FC _{c,L} or FE_{p,L}, FE_{c,L}						-
Final values FE_{p,L}, FE_{c,L}				-	-	

"

Annex A2, Addendum, paragraph 2.5.1.4.1., amend to read:

"2.5.1.4.1. Information about regeneration strategy for CO₂ emissions and fuel consumption

D — number of operating cycles between 2 cycles where regenerative phases occur: ...

d — number of operating cycles required for regeneration: ...

Applicable Type 1 cycle (Annex B4 to UN Regulation No. **154** ~~[xxx]~~) ⁽¹⁴⁾: ...

	Combined 4 phase cycle	Combined 3 phase cycle
Ki (additive / multiplicative) ⁽¹⁾ Values for CO ₂ and fuel consumption ⁽¹⁰⁾		

"

Annex A2, Addendum, paragraph 2.5.2.1.1.1., add new paragraphs 2.5.2.1.1.1.1. and 2.5.2.1.1.1.2., amend to read:

"2.5.2.1.1.1. Cycle Energy Demand: ... J

2.5.2.1.1.1.1. 4 phase cycle: ... J

2.5.2.1.1.1.2. 3 phase cycle: ... J"

Annex A2, Addendum, paragraph 2.5.2.1.1.2.3., amend to read:

"2.5.2.1.1.2.3.f₂, N/(km/h) ⁽²⁾: ...

E _{AC} (Wh)	Test	
	1	
	2	
	3	

EC (Wh/km)	Test	(as applicable)						
		Low	Medium	High	Extra High	City	Combined 4 phase cycle	Combined 3 phase cycle
Calculated EC	1							
	2							
	3							
	average							
Declared value		—	—	—	—	—		

"

Annex A2, Addendum, paragraph 2.5.2.1.2.1., add new paragraphs 2.5.2.1.2.1.1. and 2.5.2.1.2.1.2., amend to read:

"2.5.2.1.2.1. Cycle Energy Demand: ... J

2.5.2.1.2.1.1. 4 phase cycle: ... J

2.5.2.1.2.1.2. 3 phase cycle: ... J"

Annex A2, Addendum, paragraph 2.5.2.1.2.3., amend to read:

"2.5.2.1.2.2.3.f₂, N/(km/h) ⁽²⁾: ...

E _{AC} (Wh)	Test	
	1	
	2	
	3	

<i>EC (Wh/km)</i>	<i>Test</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Calculated EC	1			
	2			
	3			
	average			
Declared value		—		

<i>EC (Wh/km)</i>	<i>Test</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Calculated EC	1							
	2							
	3							
	average							
Declared value		—	—	—	—	—		

"

Annex A2, Addendum, paragraph 2.5.2.2.1., amend to read:

"2.5.2.2.1. Vehicle High

<i>PER (km)</i>	<i>Test</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Measured Pure Electric Range	1							
	2							
	3							
	average							
Declared value		—	—	—	—	—		

"

Annex A2, Addendum, paragraph 2.5.2.2.2., amend to read:

"2.5.2.2.2. Vehicle Low (if applicable)

<i>PER (km)</i>	<i>Test</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Measured Pure Electric Range	1							
	2							
	3							
	average							
Declared value		—	—	—	—	—		

<i>PER (km)</i>	<i>Test</i>	<i>City</i>	<i>Combined</i>
Measured Pure Electric Range	1		
	2		
	3		
	average		
Declared value		—	

"

Annex A2, Addendum, paragraph 2.5.3.1., amend to read:

"2.5.3.1. CO₂ mass emission charge charge-sustaining (only applicable for OVC-HEVs)"

Annex A2, Addendum, paragraph 2.5.3.1.1.1., add new paragraphs 2.5.3.1.1.1.1. and 2.5.3.1.1.1.2., amend to read:

"2.5.3.1.1.1. Cycle Energy Demand: ... J

2.5.3.1.1.1.1. 4 phase cycle: ... J

2.5.3.1.1.1.2. 3 phase cycle: ... J"

Annex A2, Addendum, paragraph 2.5.3.1.1.2.3., amend to read:

"2.5.3.1.1.2.3.f₂, N/(km/h) (°): ...

<i>CO₂ Emission (g/km)</i>	<i>Test</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>Combined 4 phase cycle</i>	<i>Combined 4 phase cycle</i>
M _{CO₂,p,5} /M _{CO₂,c,5}	1						
	2						
	3						
	Average						
Final M _{CO₂,p,H} /M _{CO₂,c,H}							

"

Annex A2, Addendum, paragraph 2.5.3.1.2.1., add new paragraphs 2.5.3.1.2.1.1. and 2.5.3.1.2.1.2., amend to read:

"2.5.3.1.2.1. Cycle Energy Demand: ... J

2.5.3.1.2.1.1. 4 phase cycle: ... J

2.5.3.1.2.1.2. 3 phase cycle:... J"

Annex A2, Addendum, paragraph 2.5.3.1.2.2.3., amend to read:

"2.5.3.1.2.2.3.f₂, N/(km/h) (°): ...

CO ₂ Emission (g/km)	Test	Low	Medium	High	Extra High	Combined 4 phase cycle
M _{CO₂,p,5} /M _{CO₂,c,5}	1					
	2					
	3					
	Average					
Final M _{CO₂,p,L} /M _{CO₂,c,L}						

"

Annex A2, Addendum, paragraph 2.5.3.1.3.1., add new paragraphs 2.5.3.1.2.1.1. and 2.5.3.1.2.1.2., amend to read:

"2.5.3.1.3.1. Cycle Energy Demand: ... J

2.5.3.1.3.1.1. 4 phase cycle:... J

2.5.3.1.3.1.2. 3 phase cycle:... J"

Annex A2, Addendum, paragraph 2.5.3.1.3.2.3., amend to read:

"2.5.3.1.3.2.3.f₂, N/(km/h) (°): ...

CO ₂ Emission (g/km)	Test	Low	Medium	High	Extra High	Combined 4 phase cycle
M _{CO₂,p,5} /M _{CO₂,c,5}	1					
	2					
	3					
	Average					
M _{CO₂,p,M} /M _{CO₂,c,M}						

"

Annex A2, Addendum, paragraph 2.5.3.2., amend to read:

"2.5.3.2. CO₂ mass emission charge charge-depleting (only applicable for OVC-HEVs)

Vehicle High

CO ₂ Emission (g/km)	Test	Combined 4 phase cycle
M _{CO₂,CD}	1	
	2	
	3	
	Average	
Final M _{CO₂,CD,H}		

Vehicle Low (if applicable)

<i>CO2 Emission (g/km)</i>	<i>Test</i>	<i>Combined 4 phase cycle</i>
M _{CO2,CD}	1	
	2	
	3	
	Average	
Final M _{CO2,CD,L}		

Vehicle M (if applicable)

<i>CO2 Emission (g/km)</i>	<i>Test</i>	<i>Combined 4 phase cycle</i>
M _{CO2,CD}	1	
	2	
	3	
	Average	
Final M _{CO2,CD,M}		

"

Annex A2, Addendum, paragraph 2.5.3.3., amend to read:

"2.5.3.3. CO₂ mass emission (weighted, combined)³ (only applicable for OVC-HEVs):

Vehicle High: M_{CO2,weighted} ... g/km

Vehicle Low (if applicable): M_{CO2,weighted} ... g/km

Vehicle M (if applicable): M_{CO2,weighted} ... g/km"

Annex A2, Addendum, paragraph 2.5.3.4., amend to read:

"2.5.3.4. Fuel consumption ~~Charge~~ **Charge-Sustaining**

<i>Vehicle High</i>						
<i>Fuel consumption (l/100 km or m³/100 km)⁽¹⁾ or fuel efficiency (km/l or km/kg)⁽¹⁾ (as applicable)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>Combined FC 4 phase cycle</i>	<i>Combined FE 3 phase cycle</i>
Final values FC _{p,H} / FC _{c,H} or FE _{p,H} , FE _{c,H}						

<i>Vehicle Low (if applicable)</i>						
<i>Fuel consumption (l/100 km or m³/100 km)⁽¹⁾ or fuel efficiency (km/l or km/kg)⁽¹⁾ (as applicable)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>Combined FC</i>	<i>Combined FE</i>

³ Measured over the combined cycle

<i>fuel efficiency (km/l or km/kg) ⁽¹⁾ (as applicable)</i>					4 phase cycle	3 phase cycle
Final values FC _{p,L} /FC _{c,L} or FE _{p,L} , FE _{c,L}						

<i>Vehicle M (if applicable)</i>						
<i>Fuel consumption (l/100 km or m³/100 km) ⁽¹⁾ or fuel efficiency (km/l or km/kg) ⁽¹⁾ (as applicable)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>Combined FC 4 phase cycle</i>	<i>Combined FE 3 phase cycle</i>
Final values FC _{p,M} / FC _{c,M} or FE _{p,M} , FE _{c,M}						

"

Annex A2, Addendum, paragraph 2.5.3.5., amend to read:

"2.5.3.5. Fuel consumption ~~Charge~~ Charge-Depleting

Vehicle High

Fuel consumption (l/100 km or m³/100 km or kg/100 km) ⁽¹⁾ or fuel efficiency (km/l or km/kg) ⁽¹⁾ (as applicable)	Fuel consumption (l/100 km or m³/100 km) ⁽¹⁾ Combined 4 phase cycle	Fuel efficiency (km/l or km/kg) ⁽¹⁾ Combined 3 phase cycle
Final values FC _{CD,H} or FE _{CD,H}		

Vehicle Low (if applicable)

Fuel consumption (l/100 km or m³/100 km or kg/100 km) ⁽¹⁾ or fuel efficiency (km/l or km/kg) ⁽¹⁾ (as applicable)	Fuel consumption (l/100 km or m³/100 km) ⁽¹⁾ Combined 4 phase cycle	Fuel efficiency (km/l or km/kg) ⁽¹⁾ Combined 3 phase cycle
Final values FC _{CD,L} or FE _{CD,L}		

Vehicle M (if applicable)

Fuel consumption (l/100 km or m³/100 km or kg/100 km) ⁽¹⁾ or fuel efficiency (km/l or km/kg) ⁽¹⁾ (as applicable)	Fuel consumption (l/100 km or m³/100 km) ⁽¹⁾ Combined 4 phase cycle	Fuel efficiency (km/l or km/kg) ⁽¹⁾ Combined 3 phase cycle
Final values FC _{CD,M} or FE _{CD,M}		

"

Annex A2, Addendum, paragraph 2.5.3.5., amend to read (including spaces between 100 and km 3 times):

- "2.5.3.6. Fuel consumption (weighted, combined)⁴ (as applicable): **for 4 phase cycle**
 Vehicle High: FC_{weighted} ... l/100 km or (kg/100 ~~km~~); or ~~FE_{weighted} ... km/l~~
 Vehicle Low (if applicable): FC_{weighted} ... l/100 km or (kg/100 ~~km~~); or ~~FE_{weighted} ... km/l~~
 Vehicle M (if applicable): FC_{weighted} ... l/100 km or (kg/100 ~~km~~); or ~~FE_{weighted} ... km/l~~"

Annex A2, Addendum, paragraph 2.5.3.7.1., amend to read:

- "2.5.3.7.1. All Electric Range AER

<i>AER (km)</i>	<i>Test</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
AER values	1			
	2			
	3			
	Average			
Final values AER				

"

Annex A2, Addendum, paragraph 2.5.3.7.2., amend to read:

- "2.5.3.7.2. Equivalent All Electric Range EAER (where applicable)

<i>EAER (km)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
EAER values							

"

Annex A2, Addendum, paragraph 2.5.3.7.3., amend to read:

- "2.5.3.7.3. Actual ~~Charge~~ **Charge-Depleting** Range R_{CDA}

<i>R_{CDA} (km)</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
R _{CDA} values		

"

Annex A2, Addendum, paragraph 2.5.3.7.4., amend to read:

- "2.5.3.7.4. ~~Charge~~ **Charge-Depleting** Cycle Range R_{CDC}

<i>R_{CDC} (km)</i>	<i>Test</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
R _{CDC} values	1		
	2		
	3		

⁴ Measured over the combined cycle

	Average		
Final values R_{CDC}			

"

Annex A2, Addendum, paragraph 2.5.3.8.1., amend to read:

"2.5.3.8.1. Electric Energy Consumption EC

EAC(Wh)							
<i>EC (Wh/km)</i>	<i>Low</i>	<i>Medium</i>	<i>High</i>	<i>Extra High</i>	<i>City</i>	<i>Combined 4 phase cycle</i>	<i>Combined 3 phase cycle</i>
Electric energy consumption values							

"

Annex A2, Addendum, paragraph 2.5.3.8.2., amend to read:

"2.5.3.8.2. UF-weighted charge-depleting electric energy consumption $EC_{AC,CD}$ (combined)

<i>EC_{AC,CD} (Wh/km)</i>	<i>Test</i>	<i>Combined 4 phase cycle</i>
EC _{AC,CD} values	1	
	2	
	3	
	Average	
Final values EC _{AC,CD}		

"

Annex A2, Addendum, paragraph 2.5.3.8.2., amend to read:

"2.5.3.8.3. UF-weighted electric energy consumption $EC_{AC,weighted}$ (combined)

<i>EC_{AC,weighted} (Wh/km)</i>	<i>Test</i>	<i>Combined 4 phase cycle</i>
EC _{AC,weighted} values	1	
	2	
	3	
	Average	
Final values EC _{AC,weighted}		

Repeat 2.5.3. in case of base vehicle. "

Annex A2, Addendum, paragraph 2.5.4., amend to read:

"2.5.4. Not Off Vehicle Charging Fuel Cell Hybrid Vehicles (NOVC-FCHV)

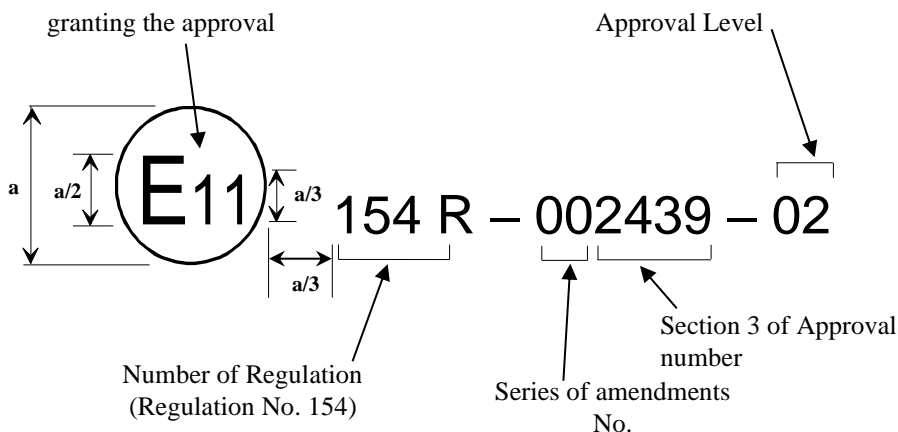
<i>Fuel Consumption (kg/100 km) or Fuel Efficiency (km/kg)⁽¹⁾</i>	<i>Fuel Consumption (kg/100 km) Combined 4 phase cycle</i>	<i>Fuel Efficiency (km/kg)⁽¹⁾ Combined 3 phase cycle</i>
Final values FC _c or FE _c		

Repeat 2.5.4. in case of base vehicle. ."

Annex A3, amend the first graphic with a space between 154 and R to read:

"

Number of country¹ Letter according to granting the approval



a = 8 mm (minimum)

Annex A3, amend the text following the second graphic to read:

" The preceding approval mark affixed to a vehicle in conformity with paragraph 5. of this Regulation shows that the vehicle type concerned has been approved in the United Kingdom (E 11), pursuant to **UN Regulation No. 154 under approval number 2439, as defined in Section 3 of paragraph 5.2.1.**~~this Regulation under Section 3 of the approval number 2439 as defined in paragraph 5.2.1.~~ This mark indicates that the approval was given in accordance with the requirements of this Regulation in its original version. Furthermore, the accompanying code (1A) denotes that the vehicle is approved to Level 1A (Europe).

The following graphic"

Annex A3, amend the text following the third graphic to read:

" The preceding approval mark affixed to a vehicle in conformity with paragraph 5. of this Regulation shows that the vehicle type concerned has been approved in France (E 2), pursuant to:

- (a) UN Regulation No. 83 under section 3 of approval number 9876. This mark indicates that the approval was given in accordance with the requirements of this Regulation with the 08 series of amendments incorporated. Furthermore, the accompanying code (ZA) denotes that the vehicle is approved under a **certain level of requirements associated with** the ZA character.
- (b) This Regulation under ~~section 3~~ of approval number 2439, **as defined in Section 3 of paragraph 5.2.1.** This mark indicates that the approval was given in accordance with the requirements of this Regulation in its original version. Furthermore, the accompanying code (1A) denotes that the vehicle is approved to Level 1A (Europe)."

¹ Number of country according to footnote in paragraph 5.4.1. of this Regulation.

Table A3/1

Characters "

Annex B1, paragraph 8., amend to read:

"8. Cycle modification

This paragraph shall not apply to OVC-HEVs, NOVC-HEVs and NOVC-FCHVs.

However, at the request of the manufacturer and with approval of the responsible authority, the downscaling procedure described in paragraph 8.2. of this annex may be applied for a NOVC-HEV using the maximum rated engine power as the maximum vehicle power rating on the applicable WLTP test cycle where the electric machine does not impact the maximum vehicle power.

In the case that the voltage of the traction REESS of a NOVC-HEV is less than 60V, the manufacturer shall supply technical evidence to the responsible authority that the electric machine does not impact the maximum vehicle power on the applicable WLTP test cycle .

In the case that the voltage of the traction REESS of a NOVC-HEV is equal to or greater than 60V, the manufacturer shall demonstrate to the responsible authority that the electric machine does not impact the maximum vehicle power on the applicable WLTP test cycle . Examples of such demonstration could include: torque/power profiles delivered from the engine and electric machine; electric machine operating envelopes; power curves; or other appropriate information to demonstrate the power delivery."

Annex B1, paragraph 8.1., amend to read:

"8.1. General remarks

Driveability problems may occur for vehicles with power to mass ratios close to the borderlines between Class 1 and Class 2 **vehicles, or between** Class 2 and Class 3 vehicles, or **for** very low powered vehicles in Class 1.

Since these problems are related mainly to cycle phases with a combination of high vehicle speed and high accelerations rather than to the maximum speed of the cycle, the downscaling procedure shall be applied to improve driveability."

Annex B2, paragraph 6., amend to read:

"6. Calculation tools

Examples of gear shift calculating tools can be found **in the UN GTR No. 15 webpage on the UNECE website.**⁵~~in the same webpage as this Regulation.~~⁶

The following tools are provided:

- (a) ACCESS based tool,
- (b) Matlab code tool
- (c) .NET ~~core~~ **framework** tool
- (d) **Python based tool**

These tools were validated by the comparison of calculation results between the ACCESS tool, the Matlab code, ~~and~~ the .NET ~~core~~ **framework** code **and the Python based tool** for 115 different vehicle configurations supplemented by additional calculations for 7 of them with additional options like "apply

⁵ <https://unece.org/transport/standards/transport/vehicle-regulations-wp29/global-technical-regulations-gtrs?accordion=15>^[link to be inserted after final notification]

⁶ ^[link to be inserted after final notification]

speed cap", "suppress downscaling", "choose other vehicle class cycle" and "choose individual n_{\min_drive} values".

The 115 vehicle configurations cover extreme technical designs for transmission and engines and all vehicle classes.

All ~~three~~ **four** tools deliver identical results with respect to gear use and clutch operation and although only the text in Annexes B1 and B2 is legally binding the tools have achieved a status that qualifies them as reference tools."

Annex B3, paragraph 4.2.5., amend the text and delete Table A3/13 to read (previous bold text remains bold):

"4.2.5. Hydrogen

For ICE vehicles fuelled by hydrogen, the reference fuel described in Table A3/18 shall be used.

Table A3/13

Hydrogen

Characteristics	Units	Limits		Test method
		Minimum	Maximum	
Hydrogen purity	% mole	98	100	ISO 14687-1
Total hydrocarbon	$\mu\text{mol/mol}$	0	100	ISO 14687-1
Water ^(a)	$\mu\text{mol/mol}$	0	(b)	ISO 14687-1
Oxygen	$\mu\text{mol/mol}$	0	(b)	ISO 14687-1
Argon	$\mu\text{mol/mol}$	0	(b)	ISO 14687-1
Nitrogen	$\mu\text{mol/mol}$	0	(b)	ISO 14687-1
CO	$\mu\text{mol/mol}$	0	1	ISO 14687-1
Sulphur	$\mu\text{mol/mol}$	0	2	ISO 14687-1
Permanent particulates ^(c)				ISO 14687-1

^(a) ~~Not to be condensed.~~

^(b) ~~Combined water, oxygen, nitrogen and argon: 1.900 $\mu\text{mol/mol}$.~~

^(c) ~~The hydrogen shall not contain dust, sand, dirt, gums, oils, or other substances in an amount sufficient to damage the fuelling station equipment or the vehicle (engine) being fuelled."~~

Annex B3, paragraph 5.4., Table A3/17, amend footnote (b) to read:

"(b) The range for cetane number is not in accordance with the requirements of a minimum range of 4R. However, in the case of a dispute between fuel supplier and fuel user, the terms of ISO 4259 may be used to resolve such disputes provided replicate measurements, of sufficient number to ~~achieve~~ ~~archive~~ the necessary precision, are made in preference to single determinations.
"

Annex B3, paragraph 6.1., replace Table A3/18 to read:

"6.1. Compressed hydrogen gas for fuel cell vehicles

Table A3/18

Hydrogen for fuel cell vehicles

Characteristics	Units	Limits		Test Method
		Minimum	Maximum	
Hydrogen fuel index ^(a)	% mole	99.97		
Total non hydrogen gases	µmol/mol		300	
Maximum concentration of individual contaminants^(f)				
Water (H ₂ O)	µmol/mol		5	e
Total hydrocarbons ^(b) (Methane basis)	µmol/mol		2	e
Oxygen (O ₂)	µmol/mol		5	e
Helium (He)	µmol/mol		300	e
Total Nitrogen (N ₂) and Argon (Ar) ^(b)	µmol/mol		100	e
Carbon dioxide (CO ₂)	µmol/mol		2	e
Carbon monoxide (CO)	µmol/mol		0.2	e
Total sulfur compounds ^(c) (H ₂ S basis)	µmol/mol		0.004	e
Formaldehyde (HCHO)	µmol/mol		0.01	e
Formic acid (HCOOH)	µmol/mol		0.2	e
Ammonia (NH ₃)	µmol/mol		0.1	e
Total halogenated compounds ^(d) (Halogenate ion basis)	µmol/mol		0.05	e

For the constituents that are additive, such as total hydrocarbons and total sulfur compounds, the sum of the constituents are to be less than or equal to the acceptable limit.

^(a) The hydrogen fuel index is determined by subtracting the "total non hydrogen gases" in this table, expressed in mole per cent, from 100 mole per cent.

^(b) Total hydrocarbons include oxygenated organic species. Total hydrocarbons shall be measured on a carbon basis (µmolC/mol). Total hydrocarbons may exceed 2 µmol/mol due only to the presence of methane, in which case the summation of methane, nitrogen and argon shall not exceed 100 µmol/mol.

^(c) As a minimum, total sulphur compounds include H₂S, COS, CS₂ and mercaptans, which are typically found in natural gas.

^(d) Total halogenated compounds include, for example, hydrogen bromide (HBr), hydrogen chloride (HCl), chlorine (Cl₂), and organic halides (R-X).

^(e) Test method shall be documented.

^(f) The analysis of specific contaminants depending on the production process shall be exempted. A vehicle manufacturer shall provide the responsible authority reasons for exempting specific contaminants.

Hydrogen for fuel cell vehicles

Characteristics	Units	Limits		Test Method
		Minimum	Maximum	
Hydrogen fuel index	% mole fraction	99.97		(a)
Total non-hydrogen gases	µmol/mol		300	
Lists of non-hydrogen gases and the specification of each contaminant ^(f)				
Water (H ₂ O)	µmol/mol		5	(e)
Total hydrocarbons ^(b) except methane (C1 equivalent)	µmol/mol		2	(e)
Methane (CH ₄)	µmol/mol		100	(e)
Oxygen (O ₂)	µmol/mol		5	(e)
Helium (He)	µmol/mol		300	(e)
Total Nitrogen (N ₂) and Argon (Ar) ^(b)	µmol/mol		300	(e)
Carbon dioxide (CO ₂)	µmol/mol		2	(e)
Carbon monoxide (CO) ^(c)	µmol/mol		0.2	(e)
Total sulfur compounds ^(d) (H ₂ S basis)	µmol/mol		0.004	(e)
Formaldehyde (HCHO)	µmol/mol		0.2	(e)
Formic acid (HCOOH)	µmol/mol		0.2	(e)
Ammonia (NH ₃)	µmol/mol		0.1	(e)
Total halogenated compounds ^(e) (Halogenate ion basis)	µmol/mol		0.05	(e)

(a) The hydrogen fuel index is determined by subtracting the “total non-hydrogen gases” in this table, expressed in mole per cent, from 100 mole per cent.

(b) Total hydrocarbons except methane include oxygenated organic species.

(c) The sum of measured CO, HCHO and HCOOH shall not exceed 0.2 µmol/mol

(d) As a minimum, total sulphur compounds include H₂S, COS, CS₂ and mercaptans, which are typically found in natural gas.

(e) Test method shall be documented. Test methods defined in ISO21087 are preferable.

(f) The analysis of specific contaminants depending on the production process shall be exempted. A vehicle manufacturer shall provide the responsible authority reasons for exempting specific contaminants."

Annex B3, paragraph 7., amend Table A3/19 to read:

"7. Technical data on fuels for Type 4 test on evaporative emissions

Table A3/19

Petrol reference fuel for Type 4 test

Parameter	Unit	Limits		Test method
		Minimum	Maximum	
Research octane number, RON		95.0	98.0	EN ISO 5164 JIS K2280
Density at 15 °C	kg/m ³	743.0	756.0	EN ISO 12185 JIS K2249-1,2,3
Vapour pressure	kPa	56.0	60.0	EN 13016-1 JIS K2258-1,2
Distillation:				
– evaporated at 70 °C	% v/v	34.0	46.0	EN ISO 3405
– evaporated at 100 °C	% v/v	54.0	62.0	EN ISO 3405
– evaporated at 150 °C	% v/v	86.0	94.0	EN ISO 3405
Hydrocarbon analysis:				
– olefins	% v/v	6.0	13.0	EN 22854 JIS K2536-1,2
– aromatics	% v/v	25.0	32.0	EN 22854 JIS K2536-1,2,3
– benzene	% v/v	-	1.00	EN 22854 EN 238 JIS K2536-2,3,4
Oxygen content	% m/m	3.3	3.7	EN 22854 JIS K2536-2,4,6
Sulphur content	mg/kg	—	10	EN ISO 20846 EN ISO 20884 JIS K2541-1,2,6,7
Lead content	mg/l	Not detected		EN 237 JIS K2255
Ethanol	% v/v	9.0	10.0	EN 22854 JIS K2536-2,4,6
MTBE		Not detected		JIS K2536-2,4,5,6 ^a
Methanol		Not detected		JIS K2536-2,4,5,6 ^a
Kerosene		Not detected		JIS K2536-2,4 ^a

^a Other method that is traceable to national or international standard may be used. "

Annex B4, paragraph 4.1.1.1., amend point (c) to read:

"(c) The arithmetic average of the vector component of the wind speed across the test road shall be less than 4 m/s. "

Annex B4, paragraph 4.1.1.2. point (c), amend to read:

"(c) The arithmetic average **of the** vector component of the wind speed across the **test** road shall be less than 4 m/s. "

Annex B4, paragraph 4.2.1.4., amend to read:

"4.2.1.4. Application of the road load matrix family

A vehicle

.

The manufacturer and the responsible authority shall agree which vehicle test model is representative.

The **values of the** vehicle parameters test mass, tyre rolling resistance and frontal area of both a vehicle H_M and L_M shall be determined in such a way that vehicle H_M produces the highest cycle energy demand and vehicle L_M the lowest cycle energy from the road load matrix family. The manufacturer and the responsible authority shall agree on the vehicle parameters for vehicles H_M and L_M .

The road load of all individual vehicles of the road load matrix family, including H_M and L_M , shall be calculated according to paragraph 5.1. of this annex."

Annex B4, paragraph 4.2.1.4., remove the hyphen and inset words to read:

"4.2.2.1. Tyre rolling resistance

Tyre rolling resistances shall be measured according to Annex 6 **to the 02 series of amendments** to UN Regulation No. 117—02, or an internationally-accepted equivalent. The rolling resistance"

Annex B4, paragraph 4.2.3., amend to read:

"4.2.3. Instrumentation

Any instruments shall be installed in such a manner as to minimise their effects on the aerodynamic characteristics of the vehicle.

If the effect of the installed instrument on $(C_D \times A_f)$ is expected to be greater than 0.015 m^2 , the **difference in the value of $(C_D \times A_f)$ of the** vehicle with and without the instrument shall be measured in a wind tunnel fulfilling the criteria in paragraph 3.2. of this annex. The corresponding difference shall be subtracted from f_2 . At the request of the manufacturer, and with approval of the responsible authority, the determined value may be used for similar vehicles where the influence of the equipment is expected to be the same."

Annex B4, paragraph 4.2.4.1., amend to read:

"4.2.4.1. On the road

Warming up shall **only** be performed by driving the vehicle ~~only~~."

Annex B4, paragraph 4.3.2.5., amend to read:

"4.3.2.5. Determination of the equation of motion

Symbols used in the on-board anemometer equations of motion are listed in Table A4/5.

Table A4/5
Symbols used in the on-board anemometer equations of motion

<i>Symbol</i>	<i>Units</i>	<i>Description</i>
A_f	m^2	frontal area of the vehicle
$a_0 \dots a_n$	degrees ⁻¹	aerodynamic drag coefficients as a function of yaw angle
A_m	N	mechanical drag coefficient
B_m	N/(km/h)	mechanical drag coefficient
C_m	N/(km/h) ²	mechanical drag coefficient
$C_D(Y)$		aerodynamic drag coefficient at yaw angle Y
D	N	drag
D_{aero}	N	aerodynamic drag
D_f	N	front axle drag (including driveline)
D_{grav}	N	gravitational drag
D_{mech}	N	mechanical drag
D_r	N	rear axle drag (including driveline)
D_{tyre}	N	tyre rolling resistance
(dh/ds)	-	sine of the slope of the track in the direction of travel (+ indicates ascending)
(dv/dt)	m/s^2	acceleration
g	m/s^2	gravitational constant
m_{av}	kg	arithmetic average mass of the test vehicle before and after road load determination
m_e	kg	effective vehicle mass including rotating components
ρ	kg/m^3	air density
t	s	time
T	K	Temperature temperature
v	km/h	vehicle speed
v_r	km/h	relative wind speed
Y	degrees	yaw angle of apparent wind relative to direction of vehicle travel

Annex B4, paragraph 4.3.2.5.3., amend to read:

"4.3.2.5.3. Aerodynamic drag modelling

The aerodynamic drag coefficient $C_D(Y)$ shall be modelled as a ~~four~~**five**-term polynomial as a function"

Annex B4, paragraph 4.5.3.1.1., amend to read:

"4.5.3.1.1. The wind ~~resistance~~ correction ~~resistance~~ w_1 for the coastdown method or w_2 for the torque meter method shall be calculated using the following equations:

$$w_1 = 3.6^2 \times f_2 \times v_w^2$$

$$\text{or: } w_2 = 3.6^2 \times c_2 \times v_w^2$$

where:

w_1 is the wind ~~resistance~~ correction ~~resistance~~ for the coastdown method, N;

- f_2 is the coefficient of the aerodynamic term determined according to paragraph 4.3.1.4.4. of this annex;
- v_w in the case that wind speed is measured at only one point, v_w is the arithmetic average vector component of the wind speed parallel to the test road during all valid run pairs m/s;
- v_w in the case that the wind speed is measured at two points, v_w is the lower of the two arithmetic average vector components of the wind speed parallel to the test road during all valid run pairs, m/s;
- w_2 is the wind **resistance** correction ~~resistance~~ for the torque meter method, Nm;
- c_2 is the coefficient of the aerodynamic term for the torque meter method determined according to paragraph 4.4.4. of this annex."

Annex B4, paragraph 4.5.5.2.1., amend to read:

"4.5.5.2.1. Correction to reference conditions

$$C^* = ((c_0(1 - K_1) - w_2) + c_1v) \times (1 + K_0(T - 20)) + K_2c_2v^2$$

where:

- C^* is the corrected running resistance, Nm;
- c_0 is the constant term as determined in paragraph 4.4.4. of this annex, Nm;
- c_1 is the coefficient of the first order term as determined in paragraph 4.4.4. of this annex, Nm/(km/h);
- c_2 is the coefficient of the second order term as determined in paragraph 4.4.4. of this annex, Nm/(km/h)²;
- K_0 is the correction factor for rolling resistance as defined in paragraph 4.5.2. of this annex;
- K_1 is the test mass correction as defined in paragraph 4.5.4. of this annex;
- K_2 is the correction factor for air resistance as defined in paragraph 4.5.1. of this annex;
- v is the vehicle velocity, km/h;
- T is the arithmetic average atmospheric temperature during all valid run pairs, °C;
- w_2 is the wind **resistance** correction ~~resistance~~ as defined in paragraph 4.5.3. of this annex."

Annex B4, paragraph 5.2.2., amend to read:

"5.2.2. The default road load force shall be calculated using the following equation:

$$F_c = f_0 + (f_1 \times v) + (f_2 \times v^2)$$

where:

- F_c is the calculated default road load force as a function of vehicle velocity, N;
- f_0 is the constant road load coefficient, N, defined by the following equation:
- $$f_0 = 0.140 \times TM;$$
- f_1 is the first order road load coefficient, N/(km/h), and shall be set to zero;

f_2 is the second order road load coefficient, $N/(km/h)^2$, defined by the following equation:

$$f_2 = (2.8 \times 10^{-6} \times TM) + (0.0170 \times \text{width} \times \text{height});$$

v is vehicle velocity, km/h;

TM test mass, kg;

width vehicle width as defined in **term No. 6.2.** of Standard ISO 612:1978, m;

height vehicle height as defined in **term No. 6.3.** of Standard ISO 612:1978, m."

Annex B4, paragraph 6.5.2.1., amend to read:

"6.5.2.1. Preconditioning

The vehicle shall be conditioned on the dynamometer as described in paragraphs 4.2.4.1.1. to 4.2.4.1.3. inclusive of this annex.

The dynamometer load setting F_d for the preconditioning shall be:

$$F_d = a_d + (b_d \times v) + (c_d \times v^2)$$

where in the case of applying paragraph 6.7.2.1:

$$a_d = 0$$

$$b_d = f_{1a};$$

$$c_d = f_{2a}$$

or, where in the case of applying paragraph 6.7.2.2.:

$$a_d = 0$$

$$b_d = 0$$

$$c_d = (C_D \times A_f) \times \frac{\rho_0}{2} \times \frac{1}{3.6^2}$$

The equivalent inertia of the dynamometer shall be the test mass.

The aerodynamic drag used for the load setting shall be **determined in accordance with** ~~taken from~~ paragraph 6.7.2. of this annex and may be set directly as input. Otherwise, a_d , b_d , and c_d from this paragraph shall be used.

At the request of the manufacturer, as an alternative to paragraph 4.2.4.1.2. of this annex, the warm-up may be conducted by driving the vehicle with the flat belt.

In this case, the warm-up speed shall be 110 per cent of the maximum speed of the applicable WLTC. The warm up is considered complete when the vehicle has been driven for at least 1,200 seconds and the change of measured force over a period of 200 seconds is less than 5 N. "

Annex B4, paragraph 6.7.2.2., amend to read:

"6.7.2.2. The aerodynamic force shall be calculated using the equation below, where the final $(C_D \times A_f)$ of that wind speed shall be used, that is also used for determination of optional equipment"

Annex B4, paragraph 6.8.2., amend to read:

"6.8.2. Determination of total road load

If the interpolation method (see paragraph 3.2.3.2. of Annex B7) is not used, the road load ~~delta method~~ **coefficients** for vehicle N shall be calculated according to the following equations:

$$f_{0,N} = f_{0,R} + f_{0,\text{Delta}}$$

$$f_{1,N} = f_{1,R} + f_{1,\text{Delta}}$$

$$f_{2,N} = f_{2,R} + f_{2,\text{Delta}}$$

where:

N refers to the road load coefficients of vehicle N;

R refers to the road load coefficients of reference vehicle R;

Delta refers to the delta road load coefficients determined in paragraph 6.8.1. of this annex."

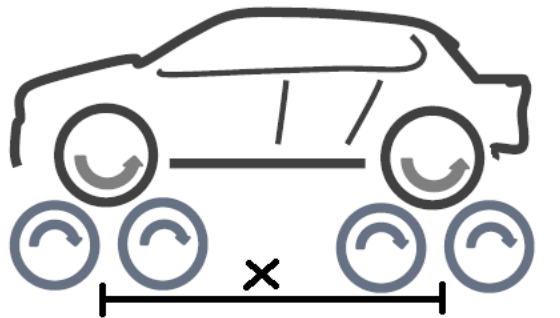
Annex B5, paragraph 2.3.1., amend to read:

"2.3.1. For testing in 4WD operation, **unless the conditions in paragraph 2.3.1.3. are met** the chassis dynamometer shall have a single roller configuration. The 4WD control system shall be designed such that the following requirements are fulfilled when tested with a vehicle driven over the WLTC."

Annex B5, add new paragraph 2.3.1.3. including a new graphic to read:

"**2.3.1.3. The usage of twin roller dynamometers with 4WD configuration should be accepted if the following conditions are met:**

- (a) **The separation distance between the front and rear sets of twin rollers of the dynamometer (X in diagram below) is set as closely as possible to match the manufacturer's declared wheelbase of the vehicle to be tested, and**
- (b) **It shall be ensured that the setting of the separation distance between the roller sets used for dyno load setting is reproduced for vehicle testing.**



Annex B5, paragraph 3.4.5.7.3., amend to read:

"3.4.5.7.3. For UFM systems without a heat exchanger, the heater shall be operated to increase the temperature of the calibration air, allowed to stabilise and data from all the instruments recorded. The temperature shall be increased in reasonable steps until the maximum ~~expected~~ diluted exhaust temperature expected during the emissions test is reached."

Annex B5, add new paragraphs 4.1.4.7. to 4.1.4.10. to read:

"**4.1.4.7. Reserved**

4.1.4.8. Reserved

4.1.4.9. Reserved

4.1.4.10. Reserved"

Annex B5, paragraph 4.3.1.2.1.3., amend to read:

"4.3.1.2.1.3. Any other sampling configuration for the PTS for which equivalent **solid** particle penetration at 30 nm can be demonstrated shall be considered acceptable."

Annex B5, paragraph 4.3.1.2.1.5., amend to read:

"4.3.1.2.1.5. Any other sampling configuration for the OT for which equivalent **solid** particle penetration at 30 nm can be demonstrated shall be considered acceptable."

Annex B5, paragraph 4.3.1.2.3., amend to read:

"4.3.1.2.3. All parts of the dilution system and the sampling system from the exhaust pipe up to the PNC, which are in contact with raw and diluted exhaust gas, shall be ~~designed to minimize deposition of the particles. All parts shall be made of electrically conductive materials that do not react with exhaust gas components, and~~ shall be electrically grounded to prevent electrostatic effects **and shall be designed to minimize deposition of the particles.**"

Annex B5, paragraph 4.3.1.3.3., amend to read:

"4.3.1.3.3. The ~~sample preconditioning unit~~ **VPR** shall:

- (a) Be capable of diluting the sample in one or more stages to achieve a particle number concentration below the upper threshold of the single particle count mode of the PNC ~~and a gas temperature below 35 °C at the inlet to the PNC;~~
- (b) **Have a gas temperature at the inlet to the PNC below the maximum allowed inlet temperature specified by the PNC manufacturer;**
- (bc) Include an initial heated dilution stage that outputs a sample at a temperature of ≥ 150 °C and ≤ 350 °C ± 10 °C, and dilutes by a factor of at least 10;
- (ed) Control heated stages to constant nominal operating temperatures, within the range ≥ 150 °C and ≤ 400 °C ± 10 °C;
- (de) Provide an indication of whether or not heated stages are at their correct operating temperatures;
- (ef) ~~Be designed to achieve~~ **Achieve** a solid particle penetration efficiency of at least 70 per cent for particles of 100 nm electrical mobility diameter;
- (fg) Achieve a particle concentration reduction factor $f_r(d_i)$ for particles of 30 nm and 50 nm electrical mobility diameters that is no more than 30 per cent and 20 per cent respectively higher, and no more than 5 per cent lower than that for particles of 100 nm electrical mobility diameter for the VPR as a whole;

The particle concentration reduction factor at each particle size $f_r(d_i)$ shall be calculated using the following equation:

$$f_r(d_i) = \frac{N_{in}(d_i)}{N_{out}(d_i)}$$

where:

$N_{in}(d_i)$ is the upstream particle number concentration for particles of diameter d_i ;

$N_{out}(d_i)$ is the downstream particle number concentration for particles of diameter d_i ;

d_i is the particle electrical mobility diameter (30, 50 or 100 nm).

$N_{in}(d_i)$ and $N_{out}(d_i)$ shall be corrected to the same conditions.

The arithmetic average particle concentration reduction factor at a given dilution setting \bar{f}_r shall be calculated using the following equation:

$$\bar{f}_r = \frac{f_r(30 \text{ nm}) + f_r(50 \text{ nm}) + f_r(100 \text{ nm})}{3}$$

It is recommended that the VPR is calibrated and validated as a complete unit;

- (gh) Be designed according to good engineering practice to ensure particle concentration reduction factors are stable across a test;
- (hi) ~~Also achieve~~ **Achieve** more than 99.0 per cent vaporization of 30 nm tetracontane ($\text{CH}_3(\text{CH}_2)_{38}\text{CH}_3$) particles, with an inlet concentration of $\geq 10,000$ per cm^3 , by means of heating and reduction of partial pressures of the tetracontane."

Annex B5, add new paragraph 4.3.1.3.3.1. to read:

"4.3.1.3.3.1 The solid particle penetration $P_r(d_i)$ at a particle size, d_i , shall be calculated using the following equation:

$$P_r(d_i) = DF \cdot N_{\text{out}}(d_i) / N_{\text{in}}(d_i)$$

Where

$N_{\text{in}}(d_i)$ **is the upstream particle number concentration for particles of diameter d_i ;**

$N_{\text{out}}(d_i)$ **is the downstream particle number concentration for particles of diameter d_i ;**

d_i **is the particle electrical mobility diameter**

DF is the dilution factor between measurement positions of $N_{\text{in}}(d_i)$ and $N_{\text{out}}(d_i)$ determined either with trace gases, or flow measurements."

Annex B5, paragraph 4.3.1.3.4., amend to read:

"4.3.1.3.4. The PNC shall:

- (a) Operate under full flow operating conditions;
- (b) Have a counting accuracy of ± 10 per cent across the range 1 per cm^3 to the upper threshold of the single particle count mode of the PNC against a suitable traceable standard. At concentrations below 100 per cm^3 , measurements averaged over extended sampling periods may be required to demonstrate the accuracy of the PNC with a high degree of statistical confidence;
- (c) Have a resolution of at least 0.1 particles per cm^3 at concentrations below 100 per cm^3 ;
- (d) ~~Have a linear response to particle number concentrations over the full measurement range in single particle count mode;~~ **Operate under single counting mode only and have a linear response to particle number concentrations within the instrument's specified measurement range;**
- (e) Have a data reporting frequency equal to or greater than a frequency of 0.5 Hz;
- (f) Have a t_{90} response time over the measured concentration range of less than 5 seconds;
- (g) ~~Incorporate a coincidence correction function up to a maximum 10 per cent correction, and may make use of an internal calibration factor as determined in paragraph 5.7.1.3. of this annex but shall not make use of any other algorithm to correct for or define the counting~~

efficiency; **Introduce a correction with an internal calibration factor as determined in paragraph 5.7.1.3. of this annex;**

- (h) Have counting efficiencies at the different particle sizes as specified in Table A5/2.
- (i) **The PNC calibration factor from the linearity calibration against a traceable reference shall be applied to determine PNC counting efficiency. The counting efficiency shall be reported including the calibration factor from linearity calibration against a traceable reference.**
- (j) **If the PNC applies some other working liquid besides n-butyl alcohol or isopropyl alcohol, the counting efficiency of the PNC shall be demonstrated with 4cSt polyalphaolefin and soot-like particles.**

Table A5/2
PNC counting efficiency

Particle size Nominal particle electrical mobility diameter (nm)	PNC counting efficiency (per cent)
23 ±1	50 ±12
41 ±1	> 90

"

Annex B5, paragraph 4.3.1.3.6., amend to read:

"4.3.1.3.6. Where not held at a known constant level at the point at which PNC flow rate is controlled, the pressure and/or temperature at the PNC inlet shall be measured for the purposes of correcting particle number concentration measurements to standard conditions. **The standard conditions are 101.325 kPa pressure and 0 °C temperature.**"

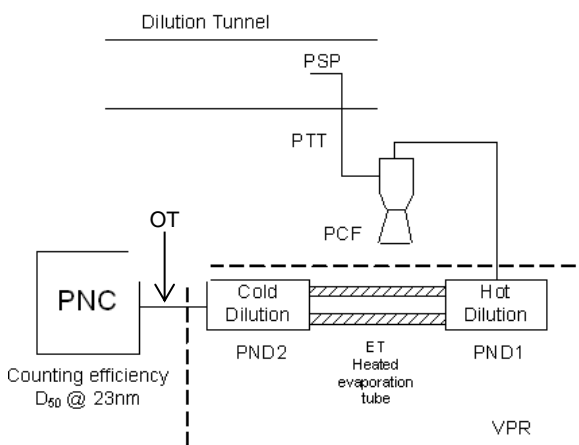
Annex B5, paragraph 4.3.1.4., amend to read:

"4.3.1.4. Recommended system description

The following paragraph contains the recommended practice for measurement of PN. However, systems meeting the performance specifications in paragraphs 4.3.1.2. and 4.3.1.3. of this annex are acceptable. **See Figure A5/14.**

Figure A5/14

A recommended particle sampling system



The evaporation tube, ET, may be catalytically active with a wall temperature of 350 °C (±10 °C)."

Annex B5, delete paragraphs 4.3.1.41. to 4.3.1.4.1.3.:

~~"4.3.1.4.1. Sampling system description~~

~~4.3.1.4.1.1. The particle sampling system shall consist of a sampling probe tip or particle sampling point in the dilution system, a PTT, a PCF, and a VPR, upstream of the PNC unit.~~

~~4.3.1.4.1.2. The VPR shall include devices for sample dilution (particle number diluters: PND₁ and PND₂) and particle evaporation (evaporation tube, ET).~~

~~4.3.1.4.1.3. The sampling probe or sampling point for the test gas flow shall be arranged within the dilution tunnel so that a representative sample gas flow is taken from a homogeneous diluent/exhaust mixture."~~

Annex B5, paragraph 4.3.1.4., amend to read:

"5.7.1.1. The responsible authority shall ensure the existence of a calibration certificate for the PNC demonstrating compliance with a traceable standard within a 13-month period prior to the emissions test. Between calibrations either the counting efficiency of the PNC shall be monitored for deterioration or the PNC wick shall be routinely changed every 6 months **if recommended by the instrument manufacturer**. See Figures A5/16 and A5/17. PNC counting efficiency may be monitored"

Annex B5, paragraph 5.7.1.3., amend to read:

"5.7.1.3. Calibration **shall be undertaken according to ISO 27891:2015 and** shall be traceable to a national or international standard ~~calibration method~~ by comparing the response of the PNC under calibration with that of:

- (a) A calibrated aerosol electrometer when simultaneously sampling electrostatically classified calibration particles; or
- (b) ~~A second PNC that has been directly calibrated by the method described above.~~ **A second full flow PNC with counting efficiency above 90 per cent for 23 nm equivalent electrical mobility diameter particles that has been calibrated by the method described above. The second PNC counting efficiency shall be taken into account in the calibration.**

Annex B5, paragraph 5.7.1.3.1., amend to read:

"5.7.1.3.1. ~~For the requirements of paragraph 5.7.1.3.(a), calibration shall be undertaken using at least six standard concentrations spaced as uniformly as possible across the PNC's measurement range.~~ **For the requirements of paragraphs 5.7.1.3.(a) and 5.7.1.3.(b), calibration shall be undertaken using at least six standard concentrations across the PNC's measurement range. These standard concentrations shall be as uniformly spaced as possible between the standard concentration of 2,000 particles per cm³ or below and the maximum of the PNC's range in single particle count mode.**"

Annex B5, paragraph 5.7.1.3.2., amend to read:

"5.7.1.3.2. ~~For the requirements of paragraph 5.7.1.3.(b), calibration shall be undertaken using at least six standard concentrations across the PNC's measurement range. At least 3 points shall be at concentrations below 1,000 per cm³, the remaining concentrations shall be linearly spaced between 1,000 per cm³ and the maximum of the PNC's range in single particle count mode.~~ **For the requirements of paragraphs 5.7.1.3.(a) and 5.7.1.3.(b), the selected points shall include a nominal zero concentration point produced by attaching HEPA filters of at least Class H13 of EN 1822:2008, or equivalent performance, to the inlet of each instrument. The gradient from a linear least squares regression of the two data sets shall be calculated and recorded. A calibration factor equal to the reciprocal of the gradient shall be applied to the PNC under calibration. Linearity of response is**

calculated as the square of the Pearson product moment correlation coefficient (r) of the two data sets and shall be equal to or greater than 0.97. In calculating both the gradient and r^2 , the linear regression shall be forced through the origin (zero concentration on both instruments). The calibration factor shall be between 0.9 and 1.1 or otherwise the PNC shall be rejected. Each concentration measured with the PNC under calibration, shall be within ± 5 per cent of the measured reference concentration multiplied with the gradient, with the exception of the zero point."

Annex B5, delete paragraphs 5.7.1.3.3. to read:

~~"5.7.1.3.3. For the requirements of paragraphs 5.7.1.3.(a) and 5.7.1.3.(b), the selected points shall include a nominal zero concentration point produced by attaching HEPA filters of at least Class H13 of EN 1822:2008, or equivalent performance, to the inlet of each instrument. With no calibration factor applied to the PNC under calibration, measured concentrations shall be within ± 10 per cent of the standard concentration for each concentration, with the exception of the zero point, otherwise the PNC under calibration shall be rejected. The gradient from a linear least squares regression of the two data sets shall be calculated and recorded. A calibration factor equal to the reciprocal of the gradient shall be applied to the PNC under calibration. Linearity of response is calculated as the square of the Pearson product moment correlation coefficient (r) of the two data sets and shall be equal to or greater than 0.97. In calculating both the gradient and r^2 , the linear regression shall be forced through the origin (zero concentration on both instruments)."~~

Annex B5, paragraph 5.7.1.4., amend to read:

"5.7.1.4. Calibration shall also include a check, according to the requirements of paragraph 4.3.1.3.4.(h) of this annex, on the PNC's ~~detection~~ **counting** efficiency with particles of 23 nm electrical mobility diameter. A check of the counting efficiency with 41 nm particles is not required **during periodical calibration**."

Annex B5, paragraph 5.7.2.1., amend to read:

"5.7.2.1. Calibration of the VPR's particle concentration reduction 13-month validation interval is permitted.

It is recommended that the VPR is calibrated and validated as a complete unit.

The VPR shall be characterised for particle concentration reduction factor with solid particles of 30, 50 and 100 nm electrical mobility diameter. Particle concentration reduction factors $f_r(d)$ for particles of 30 nm and 50 nm electrical mobility diameters shall be no more than 30 per cent and 20 per cent higher respectively, and no more than 5 per cent lower than that for particles of 100 nm electrical mobility diameter. For the purposes of validation, the arithmetic average of the particle concentration reduction factor **calculated for particles of 30 nm, 50 nm and 100 nm electrical mobility diameters** shall be within ± 10 per cent of the arithmetic average particle concentration reduction factor \bar{f}_r determined during the **latest complete**~~primary~~ calibration of the VPR."

Annex B5, add new paragraphs 5.7.2.4. and 5.7.2.5. to read:

"5.7.2.4. **The instrument manufacturer shall provide the maintenance or replacement interval that ensures that the removal efficiency of the VPR does not drop below the technical requirements. If such information is not provided, the volatile removal efficiency shall be checked yearly for each instrument.**

5.7.2.5. **The instrument manufacturer shall prove the solid particle penetration $P_r(d_i)$ by testing one unit for each PN-system model. A PN-system model here covers all PN-systems with the same hardware, i.e. same geometry, conduit materials, flows and temperature profiles in the aerosol path.**

$P_r(d_i)$ at a particle size, d_i , shall be calculated using the equation specified in paragraph 4.3.1.3.3.1."

Annex B5, paragraph 5.7.3., amend to read:

"5.7.3. PN measurement system check procedures

On a monthly basis, the flow into the PNC shall have a measured value within 5 per cent of the PNC nominal flow rate when checked with a calibrated flow meter. **Here the term 'nominal flow rate' refers to the flow rate stated in the last calibration for the PNC by the instrument manufacturer."**

Annex B6, paragraph 1.1., amend to read:

"1.1. The Type 1 test is used to verify the emissions of gaseous compounds, particulate matter, particle number (if PN measurement is required), CO₂ ~~mass~~ emission, fuel consumption, electric energy consumption and electric ranges over the applicable WLTP test cycle and OBFCM accuracy (where applicable)."

Annex B6, paragraph 1.2.3.2., amend to read:

"1.2.3.2. Depending on the vehicle type, the manufacturer shall declare as applicable the total cycle values of the CO₂ ~~mass~~ emission, the electric energy consumption, fuel consumption, fuel efficiency, as well as PER and AER according to Table A6/1."

Annex B6, paragraph 1.2.3.3., amend to read:

"1.2.3.3. For 4 phase WLTP test

The declared value of the electric energy consumption for OVC-HEVs under charge-depleting operating condition shall not be determined according to Figure A6/1. It shall be taken as the type approval value if the declared CO₂ value is accepted as the approval value. If that is not the case, the measured value of electric energy consumption shall be taken as the type approval value. Evidence of a correlation between declared CO₂ ~~mass~~ emission and electric energy consumption shall be submitted to the responsible authority in advance, if applicable.

For 3 phase WLTP test

The declared value in advance, if applicable."

Annex B6, paragraph 1.2.3.8.2., amend to read:

"1.2.3.8.2. For 4 phase WLTP test only:

If the ~~charge~~ charge-depleting Type 1 test for OVC-HEVs consists of two or more applicable WLTP test cycles and the dCO_{2x} value is below 1.0, the dCO_{2x} value shall be replaced by 1.0."

Annex B6, paragraph 1.2.3.9., amend the text before the first table of Table A6/2 to read (previous bold text remains bold):

"Table A6/2

Criteria for number of tests

For pure ICE vehicles, NOVC-HEVs and OVC-HEVs charge-sustaining Type 1 ~~test~~tests."

Annex B6, paragraph 1.2.3.9., amend the text before the second table of Table A6/2 to read:

"For OVC-HEVs charge-depleting Type 1 ~~test~~tests."

Annex B6, paragraph 1.2.3.9., amend footnote (a) to the second table of Table A6/2 to read:

"^(a) "0.9" shall be replaced by "1.0" for a charge-depleting Type 1 test for OVC-HEVs, only if the charge-depleting test contains two or more applicable WLTC cycles."

Annex B6, paragraph 1.2.4.1.1., amend to read:

"1.2.4.1.1. After the total cycle declared value of the CO₂ mass emission is accepted, the arithmetic average of the phase-specific values of the test results in g/km shall be multiplied by the adjustment factor CO₂_AF to compensate for the difference between the declared value and the test results. This corrected value shall be the type approval value for CO₂.

$$CO_2_AF = \frac{\text{Declared value}}{\text{Phase combined value}}$$

where:

$$\text{Phase combined value} = \frac{(CO_{2\text{aveL}} \times D_L) + (CO_{2\text{aveM}} \times D_M) + (CO_{2\text{aveH}} \times D_H) + (CO_{2\text{aveexH}} \times D_{\text{exH}})}{D_L + D_M + D_H + D_{\text{exH}}}$$

where:

CO_{2aveL} is the arithmetic average CO₂ mass emission result for the L phase test result(s), g/km;

CO_{2aveM} is the arithmetic average CO₂ mass emission result for the M phase test result(s), g/km;

CO_{2aveH} is the arithmetic average CO₂ mass emission result for the H phase test result(s), g/km;

CO_{2aveexH} is the arithmetic average CO₂ mass emission result for the exH phase test result(s), g/km;

D_L is theoretical distance of phase L, km;

D_M is theoretical distance of phase M, km;

D_H is theoretical distance of phase H, km;

D_{exH} is theoretical distance of phase exH, km."

Annex B6, paragraph 1.2.4.1.2., amend to read:

"1.2.4.1.2. If the total cycle declared value of the CO₂ mass emission is not accepted, the type approval phase-specific CO₂ mass emission value shall be calculated by taking the arithmetic average of the all test results for the respective phase."

Annex B6, paragraph 1.2.4.2., amend to read:

"1.2.4.2. Phase-specific values for fuel consumption

The fuel consumption value shall be calculated by the phase-specific CO₂ mass emission using the equations in paragraph 1.2.4.1. of this annex and the arithmetic average of the emissions."

Annex B6, paragraph 2.1.2, amend to read:

"2.1.2. The Type 1 test shall consist of vehicle operation on a chassis dynamometer on the applicable WLTC for the interpolation family. A proportional part of the diluted exhaust emissions shall be collected continuously for subsequent analysis using a constant volume sampler. **The applicable WLTC for each part of the procedure shall be taken from the following table:**

Vehicle type	Driven WLTC for preconditioning	Driven WLTC for Type 1 test	Calculation of final results
Pure ICE	4 phases	4 phases	3 phases and 4 phases
NOVC-HEV	4 phases	4 phases	3 phases and 4 phases

Vehicle type		Driven WLTC for preconditioning	Driven WLTC for Type 1 test	Calculation of final results
OVC-HEV	CD	Same as Type 1 test	3 phases and 4 phases (separate tests)	Same as Type 1 test and city cycle during 4 phase test
	CS	4 phases	4 phases	3 phases and 4 phases
NOVC-FCHV		4 phases	4 phases	3 phases and 4 phases
PEV		According to manufacturer's recommendation	4 phases*	3 phases, 4 phases and city cycle

* Dynamic segment of shortened Type 1 test consists of 4 phases followed by city cycle"

Annex B6, paragraph 2.3.2.2., amend the text after Figure A6/2 to read:

"This restriction does not apply ~~for~~ **in relation to** the application of a road load matrix family or when the calculation of the road load of vehicles L and H is based on the default road load."

Annex B6, paragraph 2.3.2.4., amend the text after Figure A6/4 to read:

"For 4-phase WLTP

The linearity of the corrected measured and averaged CO₂ mass emission for vehicle M, $M_{CO_2,c,6,M}$ according to step 6 of Table A7/1 of Annex B7, shall be verified against the linearly interpolated CO₂ mass emission between vehicles L and H over the applicable cycle by using the corrected measured and averaged CO₂ mass emission $M_{CO_2,c,6,H}$ of vehicle H and $M_{CO_2,c,6,L}$ of vehicle L, according to step 6 of Table A7/1 of Annex B7, for the linear CO₂ mass emission interpolation.

For 3-phase WLTP

An additional averaging of tests using the CO₂-output of step 4a is necessary (not described in Table A7/1). The linearity of the corrected measured and averaged CO₂ mass emission for vehicle M, $M_{CO_2,c,4a,M}$ according to step 4a of Table A7/1 of Annex B7, shall be verified against the linearly interpolated CO₂ mass emission between vehicles L and H over the applicable cycle by using the corrected measured and averaged CO₂ mass emission $M_{CO_2,c,4a,H}$ values of vehicle H and $M_{CO_2,c,4a,L}$ of vehicle L, according to step 4a used in of Table A7/1 of Annex B7, for the linear CO₂ mass emission interpolation.

For 3-phase and 4-phase WLTP

The linearity criterion for vehicle M (see Figure A6/5) shall be considered fulfilled, if the CO₂ mass emission of the vehicle M over the applicable WLTC minus the CO₂ mass emission derived by interpolation is less than 2 g/km or 3 per cent of the interpolated value, whichever value is lower, but at least 1 g/km."

Annex B6, paragraph 2.3.2.4., amend the text after Figure A6/5 to read:

"If the linearity criterion is fulfilled, the CO₂ values of individual vehicles shall be interpolated between vehicles L and H.

If the linearity criterion is not fulfilled, the interpolation family shall be split into two sub-families for vehicles with a cycle energy demand between vehicles L and M, and vehicles with a cycle energy demand between vehicles M and H. In such a case, the final CO₂ mass emissions of vehicle M shall be determined in accordance with the same process as for vehicles L or H. See step 9 in Table A7/1 of Annex B7.

For vehicles with a cycle energy demand between that of vehicles L and M, each parameter of vehicle H necessary for the application of the interpolation method on individual values shall be substituted by the corresponding parameter of vehicle M.

For vehicles with a cycle energy demand between that of vehicles M and H, each parameter of vehicle L necessary for the application of the interpolation method on individual values shall be substituted by the corresponding parameter of vehicle M."

Annex B6, paragraph 2.6.1.4., amend to read:

"2.6.1.4. Gaseous fuel vehicles

Between the tests on the first gaseous reference fuel and the second gaseous reference fuel, for vehicles with positive ignition engines fuelled with LPG or NG/biomethane or so equipped that they can be fuelled with either petrol or LPG or NG/biomethane, the vehicle shall be preconditioned again before the test on the second reference fuel. ~~Between the tests on the first gaseous reference fuel and the second gaseous reference fuel, for vehicles with positive ignition engines fuelled with LPG or NG/biomethane or so equipped that they can be fuelled with either petrol or LPG or NG/biomethane, the vehicle shall be preconditioned again before the test on the second reference fuel."~~

Annex B6, paragraph 2.11.1.2.2., amend to read:

"2.11.1.2.2. Each day, a zero check on the PNC, using a filter of appropriate performance at the PNC inlet, shall report a concentration of ≤ 0.2 particles per cm^3 . Upon removal of the filter, the PNC shall show an increase in measured concentration ~~to at least 100 particles per cm^3 when sampling ambient air~~ and a return to ≤ 0.2 particles per cm^3 on replacement of the filter. **The PNC shall not report any error.**"

Annex B6, Appendix 1, paragraph 3.1., amend to read:

"3.1. Calculation of the exhaust and CO_2 emissions, and fuel consumption of a single regenerative system

$$M_{si} = \frac{\sum_{j=1}^n M'_{sij}}{n} \text{ for } n \geq 1$$

$$M_{ri} = \frac{\sum_{j=1}^d M'_{rij}}{d} \text{ for } d \geq 1$$

$$M_{pi} = \frac{M_{si} \times D + M_{ri} \times d}{D + d}$$

where for each compound i considered:

M'_{sij} ~~are~~ **is** the mass emissions of compound i over test cycle j without regeneration, g/km;

M'_{rij} ~~are~~ **is** the mass emissions of compound i over test cycle j during regeneration, g/km (if $d > 1$, the first WLTC test shall be run cold and subsequent cycles hot);

M_{si} ~~are~~ **is** the mean mass emissions of compound i without regeneration, g/km;

M_{ri} ~~are~~ **is** the mean mass emissions of compound i during regeneration, g/km;

M_{pi} ~~are~~ **is** the mean mass emissions of compound i, g/km;

n is the number of test cycles, between cycles where regenerative events occur, during which emissions measurements on Type 1 WLTCs are made, **and shall be ≥ 1** ;

d is the number of complete applicable test cycles required for regeneration;

D is the number of complete applicable test cycles between two cycles where regeneration events occur.

The calculation of M_{pi} is shown graphically in Figure A6.App1/1.

Figure A6.App1/1

Parameters measured"

Annex B6, Appendix 1, paragraph 3.2., amend to read:

"3.2. Calculation of exhaust and CO₂ emissions, and fuel consumption of multiple periodically regenerating systems

The following shall be calculated for one Type 1 operation cycle for criteria emissions and for CO₂ emissions. The CO₂ emissions used for that calculation shall be from the result of step 3 described in Table A7/1 of Annex B7 **and Table A8/5 of Annex B8.**

$$M_{sik} = \frac{\sum_{j=1}^{n_k} M'_{sik,j}}{n_k} \text{ for } n_j \geq 1$$

$$M_{rik} = \frac{\sum_{j=1}^{d_k} M'_{rik,j}}{d_k} \text{ for } d \geq 1$$

$$M_{si} = \frac{\sum_{k=1}^x M_{sik} \times D_k}{\sum_{k=1}^x D_k}$$

$$M_{ri} = \frac{\sum_{k=1}^x M_{rik} \times d_k}{\sum_{k=1}^x d_k}$$

$$M_{pi} = \frac{M_{si} \times \sum_{k=1}^x D_k + M_{ri} \times \sum_{k=1}^x d_k}{\sum_{k=1}^x (D_k + d_k)}$$

$$M_{pi} = \frac{\sum_{k=1}^x (M_{sik} \times D_k + M_{rik} \times d_k)}{\sum_{k=1}^x (D_k + d_k)}$$

$$K_i \text{ factor: } K_i = \frac{M_{pi}}{M_{si}}$$

$$K_i \text{ offset: } K_i = M_{pi} - M_{si}$$

where:

M_{si} ~~are~~ **is** the mean mass emissions of all events k of compound i without regeneration, g/km;

M_{ri} ~~are~~ **is** the mean mass emissions of all events k of compound i during regeneration, g/km;

M_{pi} ~~are~~ **is** the mean mass emission of all events k of compound i, g/km;

M_{sik} ~~are~~ **is** the mean mass emissions of event k of compound i without regeneration, g/km;

M_{rik} ~~are~~ **is** the mean mass emissions of event k of compound i during regeneration, g/km;

$M'_{sik,j}$ ~~are~~ **is** the mass emissions of event k of compound i in g/km without regeneration measured at point j where $1 \leq j \leq n_k$, g/km;

$M'_{rik,j}$ ~~are~~ **is** the mass emissions of event k of compound i during regeneration (when $j > 1$, the first Type 1 test is run cold, and subsequent cycles are hot) measured at test cycle j where $1 \leq j \leq d_k$, g/km;

n_k ~~are~~ **is** the number of complete test cycles of event k, between two cycles where regenerative phases occur, during which emissions

measurements (Type 1 WLTCs or equivalent engine test bench cycles) are made, **and shall be ≥ 12** ;

d_k is the number of complete applicable test cycles of event k required for complete regeneration;

D_k is the number of complete applicable test cycles of event k between two cycles where regenerative phases occur;

x is the number of complete regeneration events.

The calculation of M_{pi} is shown graphically in Figure A6.App1/2.

Figure A6.App1/2

Parameters measured"

Annex B6, Appendix 2, paragraph 1., amend to read:

"1. General

In the case that NOVC-HEVs, OVC-HEVs, NOVC-FCHVs and OVC-FCHVs (as applicable) are tested, Appendices 2 and 3 to Annex B8 shall apply.

This appendix defines the specific provisions regarding the correction of test results for CO₂ mass-emission as a function of the energy balance ΔE_{REESS} for all REESSs.

The corrected values for CO₂ mass-emission shall correspond to a zero energy balance ($\Delta E_{REESS} = 0$), and shall be calculated using a correction coefficient determined as defined below."

Annex B6, Appendix 2, paragraph 2.1.3., amend to read:

"2.1.3. The measured current shall be integrated over time at a minimum frequency of 20 Hz, yielding the measured value of Q, expressed in ampere-hours Ah. ~~The measured current shall be integrated over time, yielding the measured value of Q, expressed in ampere-hours Ah.~~ The integration may be done in the current measurement system."

Annex B6, Appendix 2, paragraph 2.2.3., amend to read:

"2.2.3. All REESS having no influence on CO₂ mass emissions shall be excluded from monitoring."

Annex B6, Appendix 2, paragraph 3.4., amend to read:

"3.4. Correction of CO₂ mass-emission over the whole cycle ~~as a function of the correction criterion e~~"

Annex B6, Appendix 2, paragraph 3.4.1., amend to read:

"3.4.1. ~~Reserved~~ **Calculation of the correction criterion e**

~~The correction criterion e is the ratio between the absolute value of the electric energy change $\Delta E_{REESS,j}$ and the fuel energy and shall be calculated using the following equations:~~

$$e = \frac{|\Delta E_{REESS,j}|}{E_{fuel}}$$

where:

~~e~~ is the correction criterion;

~~$\Delta E_{REESS,j}$~~ is the electric energy change of all REESSs over period j determined according to paragraph 4.1. of this appendix, Wh;

j is, in this paragraph, the whole applicable WLTP test cycle;

E_{fuel} is the fuel energy according to the following equation:

$$E_{\text{fuel}} = 10 \times HV \times FC_{\text{nb}} \times d$$

where:

E_{fuel} is the energy content of the consumed fuel over the applicable WLTP test cycle, Wh;

HV is the heating value according to Table A6.App2/1, kWh/l;

FC_{nb} is the non balanced fuel consumption of the Type 1 test, not corrected for the energy balance, determined according to paragraph 6. of Annex B7, and using the results for criteria emissions and CO₂ calculated in step 2 in Table A7/1, l/100 km;

d is the distance driven over the corresponding applicable WLTP test cycle, km;

10 conversion factor to Wh. "

Annex B6, Appendix 2, paragraph 3.4.2., amend Table A6.App2/1 to read:

"

Fuel	Petrol (E10H)	Ethanol (E85)	Diesel (B5H)	LPG	CNG
Heat value	8.64 kWh/l	6.41 kWh/l	9.80 kWh/l	12.86 x ρ kWh/l	11.39 MJ/kWh/m ³

Annex B6, Appendix 2, paragraph 4.2., amend to read:

"4.2. For correction of CO₂ mass emission, g/km, combustion process-specific Willans factors from Table A6.App2/3 shall be used."

Annex B6, Appendix 2, paragraph 4.5., amend to read:

"4.5. The resulting CO₂ mass-emission difference for the considered period j due to load behaviour of the alternator for charging a REESS shall be calculated"

Annex B6a, paragraph 1.1., amend to read:

"1.1. The CO₂ emissions of ICE vehicles, NOVC-HEVs and the ~~charge~~ charge-sustaining value of OVC-HEVs shall be corrected in accordance with the requirements of this annex. No correction is required for the CO₂ value of the ~~charge-charge~~ charge-depleting test. No correction is required for an Electric Range."

Annex B6a, add new paragraph 1.2. to read:

"1.2. In order to ensure statistical representativity, at the request of the manufacturer, all tests from which results are used in the calculations described in this Annex B6A can be repeated up to a maximum of 3 times and the arithmetic average of results used in the context of this Annex B6A. Where the tests have been performed only for the purpose of determining the FCF, the results of the additional tests shall not be taken into account for any other purposes."

Annex B6a, paragraph 3.8.1., amend to read:

"3.8.1. The family correction factor, FCF , shall be calculated as follows:

$$FCF = M_{CO_2, \text{Reg}} / M_{CO_2, 23^\circ}$$

where

$M_{CO_2, 23^\circ}$ is the CO₂ mass emission of the average of all applicable Type 1 tests at 23 °C of vehicle H, after Step 3 of Table A7/1 of Annex B7 for pure ICE vehicles and after Step 3 of Table A8/5

of Annex B8 for OVC-HEVs and NOVC-HEVs, but without any further corrections, g/km;

$M_{CO_2, Treg}$ is the CO₂ mass emission over the complete WLTC cycle of the test at regional temperature after Step 3 of Table A7/1 of Annex B7 for pure ICE vehicles and after Step 3 of Table A8/5 of Annex B8 for OVC-HEVs and NOVC-HEVs but without any further corrections, g/km. For OVC-HEVs and NOVC-HEVs, the K_{CO_2} factor as defined in Appendix 2 to Annex B8 shall be used.

Both $M_{CO_2, 23^\circ}$ and $M_{CO_2, Treg}$ shall be measured on the same test vehicle.

The *FCF* shall be included in all relevant test reports.

The *FCF* shall be rounded to 4 points of decimal. "

Annex B6a, paragraph 3.8.2., amend to read:

"3.8.2. The CO₂ values for each pure ICE vehicle within the ATCT Family (as defined in paragraph 2.3. of this Annex B6a) shall be calculated using the following equations:

$$M_{CO_2, c, 5} = M_{CO_2, c, 4} \times FCF$$

$$M_{CO_2, p, 5} = M_{CO_2, p, 4} \times FCF$$

where

$M_{CO_2, c, 4}$ and $M_{CO_2, p, 4}$ are the CO₂ mass emissions over the complete WLTC, c, and the cycle phases, p, resulting from the previous calculation step, g/km;

$M_{CO_2, c, 5}$ and $M_{CO_2, p, 5}$ are the CO₂ mass emissions over the complete WLTC, c, and the cycle phases, p, including the ATCT correction, and shall be used for any further corrections or any further calculations, g/km; "

Annex B6a, paragraph 3.8.3., amend to read:

"3.8.3. The CO₂ values for each OVC-HEV and NOVC-HEV within the ATCT Family (as defined in paragraph 2.3. of this Annex B6a) shall be calculated using the following equations:

$$M_{CO_2, CS, c, 5} = M_{CO_2, CS, c, 4} \times FCF$$

$$M_{CO_2, CS, p, 5} = M_{CO_2, CS, p, 4} \times FCF$$

where

$M_{CO_2, CS, c, 4}$ and $M_{CO_2, CS, p, 4}$ are the CO₂ mass emissions over the complete WLTC, c, and the cycle phases, p, resulting from the previous calculation step, g/km;

$M_{CO_2, CS, c, 5}$ and $M_{CO_2, CS, p, 5}$ are the CO₂ mass emissions over the complete WLTC, c, and the cycle phases, p, including the ATCT correction, and shall be used for any further corrections or any further calculations, g/km. "

Annex B7, amend the rows Step No. 4c, Step No. 5, Step No. 6, Step No. 8 and Step No. 10 of Table A7/1 to read:

"

5 Result of a single test.	Output step 4b and 4c	$M_{CO_2,c,4c}$, g/km; $M_{CO_2,p,4}$, g/km.	For results after 4 phases: ATCT correction of $M_{CO_2,c,4c}$ and $M_{CO_2,p,4}$ in accordance with paragraph 3.8.2. of Annex B6a. For results after 3 phases: $M_{CO_2,c,5} = M_{CO_2,c,4c}$ $M_{CO_2,p,5} = M_{CO_2,p,4}$	$M_{CO_2,c,5}$, g/km; $M_{CO_2,p,5}$, g/km.
		$M_{i,c,4c}$, g/km; $FE_{c,4c}$, km/l;	Apply deterioration factors calculated in accordance with Annex C4 to the criteria emissions values. $FE_{c,5} = FE_{c,4c}$ In the case these values are used for the purpose of conformity of production, the further steps (6 to 10) are not required and the output of this step is the final result.	$M_{i,c,5}$, g/km; $FE_{c,5}$, km/l;
6	For results after 4 phases Output step 5	For every test: $M_{i,c,5}$, g/km; $M_{CO_2,c,5}$, g/km; $M_{CO_2,p,5}$, g/km.	Averaging of tests and declared value. Paragraphs 1.2. to 1.2.3. inclusive of Annex B6.	$M_{i,c,6}$, g/km; $M_{CO_2,c,6}$, g/km; $M_{CO_2,p,6}$, g/km. $M_{CO_2,c,declared}$, g/km.
	For results after 3 phases Output step 5	$FE_{c,5}$, km/l; $M_{i,c,4c}$, g/km	Averaging of tests and declared value. Paragraphs 1.2. to 1.2.3. inclusive of Annex B6. The conversion from $FE_{c,declared}$ to $M_{CO_2,c,declared}$ shall be performed for the applicable cycle according to paragraph 6. of Annex B7. For that purpose, the criteria emission over the applicable cycle shall be used.	$FE_{c,declared}$, km/l $FE_{c,6}$, km/l $M_{CO_2,c,declared}$, g/km.
7	For results after 4 phases Output step 6	$M_{CO_2,c,6}$, g/km; $M_{CO_2,p,6}$, g/km. $M_{CO_2,c,declared}$, g/km.	Alignment of phase values. Paragraph 1.2.4. of Annex B6. and: $M_{CO_2,c,7} = M_{CO_2,c,declared}$	$M_{CO_2,c,7}$, g/km; $M_{CO_2,p,7}$, g/km.
	For results after 3 phases Output step 5 Output step 6	$M_{CO_2,c,5}$, g/km; $M_{CO_2,p,5}$, g/km; $M_{CO_2,c,declared}$, g/km.	Alignment of phase values. Paragraph 1.2.4. of Annex B6.	$M_{CO_2,p,7}$, g/km.

<p>8</p> <p>Result of a Type 1 test for a test vehicle.</p>	<p>For results after 4 phases</p> <p>Output steps 6</p> <p>Output steps 7</p>	<p>$M_{i,c,6}$, g/km;</p> <p>$M_{CO_2,c,7}$, g/km;</p> <p>$M_{CO_2,p,7}$, g/km.</p>	<p>Calculation of fuel consumption according to paragraph 6 of this annex.</p> <p>The calculation of fuel consumption shall be performed for the applicable cycle and its phases separately. For that purpose:</p> <p>(a) the applicable phase or cycle CO₂ values shall be used;</p> <p>(b) the criteria emission over the complete cycle shall be used.</p> <p>and:</p> <p>$M_{i,c,8} = M_{i,c,6}$</p> <p>$M_{CO_2,c,8} = M_{CO_2,c,7}$</p> <p>$M_{CO_2,p,8} = M_{CO_2,p,7}$</p>	<p>$FC_{c,8}$, l/100 km;</p> <p>$FC_{p,8}$, l/100 km;</p> <p>$M_{i,c,8}$, g/km;</p> <p>$M_{CO_2,c,8}$, g/km;</p> <p>$M_{CO_2,p,8}$, g/km.</p>
	<p>For results after 3 phases</p> <p>Output steps 56</p> <p>Output steps 7</p>	<p>$M_{i,c,6}$, $M_{i,c,5}$, g/km;</p> <p>$M_{CO_2,p,7}$, g/km.</p>	<p>Calculation of fuel consumption and conversion to fuel efficiency for phase value only according to Paragraph 6 of this annex.</p> <p>The calculation of fuel consumption shall be performed for the phases separately. For that purpose:</p> <p>(a) the applicable phase CO₂ values shall be used;</p> <p>(b) the criteria emission over the complete cycle shall be used.</p> <p>and:</p> <p>$M_{i,c,8} = M_{i,c,5}$</p> <p>$FE_{c,8} = FE_{c,6}$</p>	<p>$FC_{p,8}$, l/100 km;</p> <p>$FE_{p,8}$, km/l;</p> <p>$M_{i,c,8}$, g/km;</p> <p>$FE_{c,8}$, km/l.</p>
<p>9</p> <p>Interpolation family result.</p> <p>For results after 4 phases</p> <p>Final criteria emission result</p>	<p>Output step 8</p>	<p>For each of the test vehicles H and L:</p> <p>$M_{i,c,8}$, g/km;</p> <p>$M_{CO_2,c,8}$, g/km;</p> <p>$M_{CO_2,p,8}$, g/km;</p> <p>$FC_{c,8}$, l/100 km;</p> <p>$FC_{p,8}$, l/100 km;</p> <p>$FE_{c,8}$, km/l.</p> <p>$FE_{p,8}$, km/l</p>	<p>For results after 4 phases;</p> <p>If in addition to a test vehicle H a test vehicle L M and/or, if applicable, vehicle M L was also tested, the resulting criteria emission value shall be the highest of the two or, in case vehicle M does not meet the linearity criterion if applicable, three values and referred to as $M_{i,c}$.</p> <p>In the case of the combined THC + NO_x emissions, the highest value of the sum referring to either the vehicle H or vehicle L or, if applicable, vehicle M is to be taken as the type approval value.</p> <p>Otherwise, if no vehicle L was tested, $M_{i,c} = M_{i,c,8}$</p> <p>For CO₂, FE and FC, the values derived in step 8 shall be used, and CO₂ values shall be rounded according to paragraph 6.1.8. of this Regulation to two places of decimal, and FE and FC values shall be rounded according to paragraph 6.1.8. of this Regulation to three places of decimal.</p>	<p>$M_{i,c}$, g/km;</p> <p>$M_{CO_2,c,H}$, g/km;</p> <p>$M_{CO_2,p,H}$, g/km;</p> <p>$FC_{c,H}$, l/100 km;</p> <p>$FC_{p,H}$, l/100 km;</p> <p>$FE_{c,H}$, km/l;</p> <p>$FE_{p,H}$, km/l;</p> <p>and if a vehicle L was tested:</p> <p>$M_{CO_2,c,L}$, g/km;</p> <p>$M_{CO_2,p,L}$, g/km;</p> <p>$FC_{c,L}$, l/100 km;</p> <p>$FC_{p,L}$, l/100 km;</p> <p>$FE_{c,L}$, km/l;</p> <p>$FE_{p,L}$, km/l.</p>

<p>10 Result of an individual vehicle. Final CO₂, FE and FC result.</p>	<p>Output step 9</p>	<p>M_{CO₂,c,H}, g/km; M_{CO₂,p,H}, g/km; FC_{c,H}, l/100 km; FC_{p,H}, l/100 km; FE_{c,H}, km/l; FE_{p,H}, km/l; and if a vehicle L was tested: M_{CO₂,c,L}, g/km; M_{CO₂,p,L}, g/km; FC_{c,L}, l/100 km; FC_{p,L}, l/100 km. FE_{c,L}, km/l; FE_{p,L}, km/l.</p>	<p>Fuel consumption, fuel efficiency and CO₂ calculations for individual vehicles in an interpolation family. Paragraph 3.2.3. of this annex. Fuel consumption, fuel efficiency and CO₂ calculations for individual vehicles in a road load matrix family. Paragraph 3.2.4. of this annex. CO₂ emissions shall be expressed in grams per kilometre (g/km) rounded to the nearest whole number; FC values shall be rounded according to paragraph 6.1.8. of this Regulation to one place of decimal, expressed in (l/100 km) ; FE values shall be rounded according to paragraph 6.1.8. of this Regulation to one place of decimal, expressed in (km/l).</p>	<p>M_{CO₂,c,ind} g/km; M_{CO₂,p,ind}, g/km; FC_{c,ind} l/100 km; FC_{p,ind}, l/100 km; FE_{c,ind}, km/l;- FE_{p,ind}, km/l.</p>
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"

Annex B7, paragraph 3.2.1.1.4., amend to read:

"3.2.1.1.4. Flow-weighted arithmetic average concentration calculation

The following calculation method shall be applied for CVS systems that are not equipped with a heat exchanger or for CVS systems with a heat exchanger that does not comply with paragraph 3.3.5.1. of Annex B5.

This flow weighted"

Annex B7, paragraph 3.2.3.2.2.1., amend to read:

"3.2.3.2.2.1. Mass of an individual vehicle

The test masses of vehicles H and L shall be used as input for the interpolation method.

TM_{ind}, in kg, shall be the ~~individual~~ test mass of ~~the~~ **an individual** vehicle according to paragraph 3.2.25. of this Regulation.

If the same test mass is used for test vehicles L and H, the value of TM_{ind} shall be set to the mass of test vehicle H for the interpolation method."

Annex B7, paragraph 3.2.3.2.2.3.2.1., amend to read:

"3.2.3.2.2.3.2.1. The manufacturer shall ~~submit the declared~~ **declare the** scope of applicable vehicles for the alternative method **to the responsible authority** and the declared scope shall be documented ~~to~~ **in** relevant test reports when evidence of equivalency is shown to the responsible authority. The responsible authority may request the confirmation of equivalency for the alternative method by selecting the vehicle from the scope declared by the manufacturer after equivalency was demonstrated. The result shall fulfil an accuracy for $\Delta(CD \times Af)$ of ± 0.015 m². This procedure shall be based on wind tunnel measurements fulfilling the criteria of this Regulation. If this procedure is not satisfied, the approval of the alternative method is regarded as invalidated."

Annex B7, paragraph 4., amend to read:

"4. Determination of PN (if PN measurement is required)

PN shall be calculated

.

C_b is either the dilution air or the dilution tunnel background particle number concentration, as permitted by the responsible authority, in particles per cubic centimetre, corrected for coincidence and to standard conditions (273.15 K (0 °C) and 101.325 kPa);

\bar{f}_r is the mean

.

where:

C_i is a discrete measurement of particle number concentration in the diluted gas exhaust from the PNC; particles per cm³ and corrected for coincidence;

n is the total number"

Annex B7, paragraph 6.2., amend to read:

"6.2. For 4-phase WLTP test

The fuel consumption values shall be calculated from the emissions of hydrocarbons, carbon monoxide, and carbon dioxide using the results of step 6 for criteria emissions and step 7 for CO₂ of Table A7/1.

For 3-phase WLTP test

The fuel efficiency values shall be calculated from the emissions of hydrocarbons, carbon monoxide, and carbon dioxide using the results of **the step as specified in the input column of the relevant table of this annex or Annex B8**~~step 2 for criteria emissions and step 4a for CO₂~~ of Table A7/1."

Annex B7, paragraph 7.1., amend to read:

"7.1. General requirement

The prescribed speed between time points in Tables A1/1 to A1/12 shall be determined by linear interpolation at a frequency of 10 Hz.

In the case that the accelerator control is fully activated, the prescribed speed shall be used instead of the actual vehicle speed for drive trace index calculations during such periods of operation.

In the case of vehicles equipped with a manual transmission, it is allowed to exclude drive trace indices calculation during upward gear shift operation. From the moment of actual vehicle clutch operation until the actual vehicle speed has reached the prescribed speed in the higher gear shall be a maximum of 2 seconds. The type approval authority may request the manufacturer to demonstrate that it is not possible to meet the drive trace requirements without such exclusion, as a result of the design of the vehicle.

The on-board diagnostics (OBD) or electronic control unit (ECU) monitoring (data collection) system may be used in order to detect the position of the accelerator control. The collection of OBD and/or ECU data shall not influence the vehicle's emissions or performance."

Annex B7, paragraph 7.2.4.3., amend to read:

"7.4.2.3. City cycle test (paragraph 3.2.4.3. of Annex B8 replacing WLTC with WLTC_{city})

For the application of the drive trace index calculation, two consecutively driven city test cycles (L and M) shall be considered as one cycle.

For the city cycle during which the combustion engine starts to consume fuel, the drive indices IWR and RMSSE shall not be calculated individually. Instead, depending on the number of completed city cycles before the city cycle during which the combustion engine ~~start~~**starts**, the incomplete city cycle shall be combined with the previous city cycles as follows and shall be considered as one cycle in the context of the drive trace index calculations.

If the number of completed city cycles

.

. or greater than +5.0 per cent."

Annex B8, paragraph 1.1., amend to read:

"1.1. Units, accuracy and resolution

.

{Table A8/2

(Reserved)}"

Annex B8, paragraph 1.1., amend to read:

"1.3.2. In the case of OVC-HEVs and NOVC-HEVs, the final criteria emission results shall be rounded according to paragraph 1.3.2. of Annex B7, the NO_x correction factor KH shall be rounded according to paragraph 1.3.3. of Annex B7, and the dilution factor DF shall be rounded according to paragraph 1.3.4. of Annex B7.;"

Annex B8, paragraph 2.4., amend to read:

"2.4. All REESS having no influence on CO₂ ~~mass~~ emissions or H₂ consumption shall be excluded from monitoring."

Annex B8, paragraph 3.1.1.5., amend to read:

"3.1.1.5. **For OVC-HEVs and NOVC-HEVs, gaseous emission compounds and particle number (if PN measurement is required), shall be analysed for each individual test phase. For phases where no combustion engine operates, it is permitted to omit the phase analysis and to set the emission results to zero.**~~For OVC HEVs and NOVC HEVs, gaseous emission compounds, shall be analysed for each individual test phase. It is permitted to omit the phase analysis for phases where no combustion engine operates.~~"

Annex B8, paragraph 3.1.1.6., amend to read:

"3.1.1.6. **For OVC-HEVs and NOVC-HEVs, without prejudice to paragraph 2.10.1.1. of Annex B6, particulate matter emission shall be analysed for each applicable test cycle. For cycles where no combustion engine operates, it is permitted to set the emission results to zero.**~~If applicable, particle number shall be analysed for each individual phase and particulate matter emission shall be analysed for each applicable test cycle.~~"

Annex B8, paragraph 3.2.5.3.2., amend to read:

"3.2.5.3.2. If required, **the** CO₂ ~~mass~~ emission shall be corrected according to Appendix 2 to this annex."

Annex B8, paragraph 3.2.5.3.2., amend to read:

"3.3.3.2. If required, the CO₂ ~~mass~~ emission shall be corrected according to Appendix 2 to this annex."

Annex B8, paragraph 3.2.5.3.2., amend the text before Table A8/5 to read:

"4.1.1.1. Stepwise procedure for calculating the final test results of the charge-sustaining Type 1 test for NOVC-HEVs and OVC-HEVs

The results shall be calculated in the order described in Table A8/5. All applicable results in the column "Output" shall be recorded. The column "Process" describes the paragraphs to be used for calculation or contains additional calculations.

For the purpose of this table, the following nomenclature within the equations and results is used:

- c complete applicable test cycle;
- p every applicable cycle phase; for the purpose of EAER_{city} calculation (as applicable), p shall represent the city driving cycle;
- i applicable criteria emission component (except CO₂);
- CS charge-sustaining;
- CO₂ CO₂ mass emission."

Annex B8, paragraph 3.2.5.3.2. amend the rows Step No. 2, Step No. 5, Step No. 6, Step No. 8 and Step No. 9 of Table A8/5 to read:

"

2	Output step 1	M _{i,CS,p,1} , g/km; M _{CO2,CS,p,1} , g/km.	<p>Calculation of combined charge-sustaining cycle values:</p> $M_{i,CS,c,2} = \frac{\sum_p M_{i,CS,p,1} \times d_p}{\sum_p d_p}$ $M_{CO2,CS,c,2} = \frac{\sum_p M_{CO2,CS,p,1} \times d_p}{\sum_p d_p}$ <p>where:</p> <p>M_{i,CS,c,2} is the charge-sustaining mass emission result over the total cycle;</p> <p>M_{CO2,CS,c,2} is the charge-sustaining CO₂ mass emission result over the total cycle;</p> <p>d_p are the driven distances of the cycle phases p.</p>	M _{i,CS,c,2} , g/km; M _{CO2,CS,c,2} , g/km.
5 Result of a single test.	Output step 4b and 4c	M _{CO2,CS,p,4} , g/km; M _{CO2,CS,c,4c} , g/km;	<p>For results after 4 phases:</p> <p>ATCT correction of M_{CO2,CS,c,4c} and M_{CO2,CS,p,4} in accordance with paragraph 3.8.2. of Annex B6a.</p> <p>For results after 3 phases:</p> $M_{CO2,c,5} = M_{CO2,c,4c}$ $M_{CO2,p,5} = M_{CO2,p,4}$	M _{CO2,CS,c,5} , g/km; M _{CO2,CS,p,5} , g/km.
		M _{i,CS,c,4c} , g/km; FE _{c,4c} , km/l;	<p>Apply deterioration factors calculated in accordance with Annex C4 to the criteria emissions values.</p> $FE_{c,5} = FE_{c,4c}$ <p>In the case these values are used for the purpose of conformity of production, the further steps (6 to</p>	M _{i,CS,c,5} , g/km; FE _{c,5} , km/l;

			9) are not required and the output of this step is the final result.	
6 $M_{i,CS}$ results of a Type 1 test for a test vehicle.	For results after 4 phases Output step 5	For every test: $M_{i,CS,c,5}$, g/km; $M_{CO_2,CS,c,5}$, g/km; $M_{CO_2,CS,p,5}$, g/km.	Averaging of tests and declared value according to paragraphs 1.2. to 1.2.3. inclusive of Annex B6.	$M_{i,CS,c,6}$, g/km; $M_{CO_2,CS,c,6}$, g/km; $M_{CO_2,CS,p,6}$, g/km; $M_{CO_2,CS,c,declared}$, g/km.
	For results after 3 phases Output step 5	$FE_{c,5}$, km/l; $M_{i,CS,c,4c}$	Averaging of tests and declared value. Paragraphs 1.2. to 1.2.3. inclusive of Annex B6. The conversion from $FE_{c,declared}$ to $M_{CO_2,c,declared}$ shall be performed for the applicable cycle. For that purpose, the criteria emission over the complete cycle shall be used.	$FE_{c,declared}$, km/l $M_{CO_2,c,declared}$, g/km.
For results after 4 phases only 8 Interpolation family result. Final criteria emission result. If the interpolation method is not applied, step No. 9 is not required and the output of this step is the final CO ₂ result.	Output step 6 Output step 7	For each of the test vehicles H and L and, if applicable, vehicle M: $M_{i,CS,c,6}$, g/km; For each of the test vehicles H and L and, if applicable, vehicle M: $M_{CO_2,CS,c,7}$, g/km; $M_{CO_2,CS,p,7}$, g/km.	If in addition to a test vehicle H a test vehicle L-M and/or, if applicable vehicle M-L was also tested, the resulting criteria emission value shall be the highest of the two or, in case vehicle M does not meet the linearity criterion if applicable , three values and referred to as $M_{i,CS,c}$ In the case of the combined THC+NO _x emissions, the highest value of the sum referring to either the vehicle H or vehicle L or, if applicable, vehicle M is to be taken as the type approval value. Otherwise, if no vehicle L or if applicable vehicle M was tested, $M_{i,CS,c} = M_{i,CS,c,6}$	$M_{i,CS,c}$, g/km; $M_{CO_2,CS,c}$, g/km; $M_{CO_2,CS,p}$, g/km;

			<p>In the case that the interpolation method is applied, intermediate rounding shall be applied according to paragraph 6.1.8. of this Regulation:</p> <p>CO₂ values derived in step 7 of this table shall be rounded to two places of decimal. Also, the output for CO₂ is available for vehicles vehicle H and vehicle L and, if applicable, for vehicle M.</p> <p>In the case that the interpolation method is not applied, final rounding shall be applied according to paragraph 6.1.8. of this Regulation:</p> <p>CO₂ values derived in step 7 of this table shall be rounded to the nearest whole number.</p>	
<p>For results after 4 phases only</p> <p>9</p> <p>Result of an individual vehicle.</p> <p>Final CO₂ result.</p>	Output step 8	<p>M_{CO₂,CS,c}, g/km;</p> <p>M_{CO₂,CS,p}, g/km;</p>	<p>CO₂ mass emission calculation according to paragraph 4.5.4.1. of this annex for individual vehicles in an interpolation family.</p> <p>Final rounding of individual vehicle CO₂ values shall be performed according to paragraph 6.1.8. of this Regulation.</p> <p>CO₂ values shall be rounded to the nearest whole number.</p> <p>Output is available for each individual vehicle.</p>	<p>M_{CO₂,CS,c,ind}, g/km;</p> <p>M_{CO₂,CS,p,ind}, g/km.</p>

"

Annex B8, paragraph 4.1.1.2., amend to read:

"4.1.1.2. In the case that the correction according to paragraph 1.1.4. of Appendix 2 to this annex was not applied, the following charge-sustaining CO₂ ~~mass~~ emission shall be used:

$$M_{CO_2,CS} = M_{CO_2,CS,nb}$$

where:

M_{CO₂,CS} is the charge-sustaining CO₂ ~~mass~~ emission of the charge-sustaining Type 1 test according to Table A8/5, step No. 3, g/km;

M_{CO₂,CS,nb} is the non-balanced charge-sustaining CO₂ ~~mass~~ emission of the charge-sustaining Type 1 test, not corrected for the energy balance, determined according to Table A8/5, step No. 2, g/km."

Annex B8, paragraph 4.1.1.3., amend to read:

"4.1.1.3. If the correction of the charge-sustaining CO₂ ~~mass~~ emission is required according to paragraph 1.1.3. of Appendix 2 to this annex or in the case that the correction according to paragraph 1.1.4. of Appendix 2 to this annex was applied, the CO₂ ~~mass~~ emission correction coefficient shall be determined according to paragraph 2.

of Appendix 2 to this annex. The corrected charge-sustaining CO₂ ~~mass~~-emission shall be determined using the following equation:

$$M_{CO_2,CS} = M_{CO_2,CS,nb} - K_{CO_2} \times EC_{DC,CS}$$

where:

- $M_{CO_2,CS}$ is the charge-sustaining CO₂ ~~mass~~-emission of the charge-sustaining Type 1 test according to Table A8/5, step No. 3, g/km;
- $M_{CO_2,CS,nb}$ is the non-balanced CO₂ ~~mass~~-emission of the charge-sustaining Type 1 test, not corrected for the energy balance, determined according to Table A8/5, step No. 2, g/km;
- $EC_{DC,CS}$ is the electric energy consumption of the charge-sustaining Type 1 test according to paragraph 4.3. of this annex, Wh/km;
- K_{CO_2} is the CO₂ ~~mass~~-emission correction coefficient according to paragraph 2.3.2. of Appendix 2 to this annex, (g/km)/(Wh/km)."

Annex B8, paragraph 4.1.1.4., amend to read:

- "4.1.1.4. In the case that phase-specific CO₂ ~~mass~~-emission correction coefficients have not been determined, the phase-specific CO₂ ~~mass~~-emission shall be calculated using the following equation:

$$M_{CO_2,CS,p} = M_{CO_2,CS,nb,p} - K_{CO_2} \times EC_{DC,CS,p}$$

where:

- $M_{CO_2,CS,p}$ is the charge-sustaining CO₂ ~~mass~~-emission of phase p of the charge-sustaining Type 1 test according to Table A8/5, step No. 3, g/km;
- $M_{CO_2,CS,nb,p}$ is the non-balanced CO₂ ~~mass~~-emission of phase p of the charge-sustaining Type 1 test, not corrected for the energy balance, determined according to Table A8/5, step No. 1, g/km;
- $EC_{DC,CS,p}$ is the electric energy consumption of phase p of the charge-sustaining Type 1 test according to paragraph 4.3. of this annex, Wh/km;
- K_{CO_2} is the CO₂ ~~mass~~-emission correction coefficient according to paragraph 2.3.2. of Appendix 2 to this annex, (g/km)/(Wh/km)."

Annex B8, paragraph 4.1.1.5., amend to read:

- "4.1.1.5. In the case that phase-specific CO₂ ~~mass~~-emission correction coefficients have been determined, the phase-specific CO₂ ~~mass~~-emission shall be calculated using the following equation:

$$M_{CO_2,CS,p} = M_{CO_2,CS,nb,p} - K_{CO_2,p} \times EC_{DC,CS,p}$$

where:

- $M_{CO_2,CS,p}$ is the charge-sustaining CO₂ ~~mass~~-emission of phase p of the charge-sustaining Type 1 test according to Table A8/5, step No. 3, g/km;
- $M_{CO_2,CS,nb,p}$ is the non-balanced CO₂ ~~mass~~-emission of phase p of the charge-sustaining Type 1 test, not corrected for the energy balance, determined according to Table A8/5, step No. 1, g/km;
- $EC_{DC,CS,p}$ is the electric energy consumption of phase p of the charge-sustaining Type 1 test, determined according to paragraph 4.3. of this annex, Wh/km;

- $K_{CO_2,p}$ is the CO₂ ~~mass~~-emission correction coefficient according to paragraph 2.3.2.2. of Appendix 2 to this annex, (g/km)/(Wh/km);
- p is the index of the individual phase within the applicable WLTP test cycle

Annex B8, paragraph 4.1.2., amend to read:

"4.1.2. Charge-depleting CO₂ ~~mass~~-emission for OVC-HEVs

For 4-phase WLTP test

The utility factor-weighted charge-depleting CO₂ ~~mass~~-emission $M_{CO_2,CD}$ shall be calculated using the following equation:

$$M_{CO_2,CD} = \frac{\sum_{j=1}^k (UF_j \times M_{CO_2,CD,j})}{\sum_{j=1}^k UF_j}$$

For 3-phase WLTP test

The charge-depleting CO₂ ~~mass~~-emission $M_{CO_2,CD}$ shall be calculated using the following equation:

$$M_{CO_2,CD} = \frac{\sum_{j=1}^k (M_{CO_2,CD,j} \times d_j)}{\sum_{j=1}^k d_j}$$

where:

- $M_{CO_2,CD}$ is the utility factor-weighted charge-depleting CO₂ ~~mass~~ emission, g/km;
- $M_{CO_2,CD,j}$ is the CO₂ ~~mass~~-emission determined according to paragraph 3.2.1. of Annex B7 of phase j of the charge-depleting Type 1 test, g/km;
- UF_j is the utility factor of phase j according to Appendix 5 to this annex;
- j is the index number of the considered phase;
- k is the number of phases driven up to the end of the transition cycle according to paragraph 3.2.4.4. of this annex.

In the case that the interpolation method is applied, k shall be the number of phases driven up to the end of the transition cycle of vehicle L, $n_{veh,L}$.

If the transition cycle number driven by vehicle H, $n_{veh,H}$, and, if applicable, by an individual vehicle within the vehicle interpolation family, $n_{veh,ind}$, is lower than the transition cycle number driven by vehicle L, $n_{veh,L}$, the confirmation cycle of vehicle H and, if applicable, an individual vehicle shall be included in the calculation. The CO₂ ~~mass~~-emission of each phase of the confirmation cycle shall be subsequently corrected to an electric energy consumption of zero ($EC_{DC,CD,j} = 0$) by using the CO₂ correction coefficient according to Appendix 2 to this annex."

Annex B8, paragraph 4.1.3.1., amend to read:

"4.1.3.1. The utility factor-weighted mass emission of gaseous compounds

$$M_{i,weighted} = \sum_{j=1}^k (UF_j \times M_{i,CD,j}) + (1 - \sum_{j=1}^k UF_j) \times M_{i,CS}$$

where:

- $M_{i,weighted}$ is the utility factor-weighted mass emission compound i, g/km;

- i is the index of the considered gaseous emission compound (except CO₂);
- UF_j is the utility factor of phase j according to Appendix 5 to this annex;
- $M_{i,CD,j}$ is the mass emission of the gaseous emission compound i determined according to paragraph 3.2.1. of Annex B7 of phase j of the charge-depleting Type 1 test, g/km;
- $M_{i,CS}$ is the charge-sustaining mass emission of gaseous emission compound i for the charge-sustaining Type 1 test according to Table A8/5, step No. 6, g/km;
- j is the index number of the considered phase;
- k is the number of phases driven until the end of the transition cycle according to paragraph 3.2.4.4. of this annex.

For calculating the utility-factor weighted CO₂ ~~mass~~ emission the following equation shall be used:

$$M_{CO_2,weighted} = \left(\sum_{j=1}^k UF_j \right)_{ave} \times M_{CO_2,CD,declared} + \left(1 - \left(\sum_{j=1}^k UF_j \right)_{ave} \right) \times M_{CO_2,CS,declared}$$

where:

- $M_{CO_2,weighted}$ is the utility-factor weighted charge-depleting CO₂ ~~mass~~ emission, g/km.
- $M_{CO_2,CD,declared}$ is the declared charge-depleting CO₂ ~~mass~~ emission according to Table A8/8, step no. 14, g/km.
- $M_{CO_2,CS,declared}$ is the declared charge-sustaining CO₂ ~~mass~~ emission according to Table A8/5, step no. 7, g/km.
- $\left(\sum_{j=1}^k UF_j \right)_{ave}$ is the average of the sum of utility factors of each charge-depleting test.
- j is the index number of the considered phase;
- k is the number of phases driven until the end of the transition cycle according to paragraph 3.2.4.4. of this annex.

In the case that the interpolation method is applied for CO₂, k shall be the number of phases driven up to the end of the transition cycle of vehicle L $n_{veh,L}$. for the application of both equations of this paragraph.

If the transition cycle number driven by vehicle H, $n_{veh,H}$, and, if applicable, by an individual vehicle within the vehicle interpolation family $n_{veh,ind}$ is lower than the transition cycle number driven by vehicle L, $n_{veh,L}$, the confirmation cycle of vehicle H and, if applicable, an individual vehicle shall be included in the calculation. The CO₂ ~~mass~~ emission of each phase of the confirmation cycle shall then be corrected to an electric energy consumption of zero ($EC_{DC,CD,j} = 0$) by using the CO₂ correction coefficient according to Appendix 2 to this annex. "

Annex B8, paragraph 4.2.1.1., amend the row Step No. 2 of Table A8/6 to read:

"

<p>2</p> <p>Interpolation family result.</p> <p>If the interpolation method is not applied, step No. 3 is not required and the output of this step is the final result.</p>	<p>Output step 1</p>	<p>FC_{CS,c,1}, l/100 km; FC_{CS,p,1}, l/100 km; FE_{CS,c,1}, km/l. FE_{CS,p,1}, km/l</p>	<p>For FC and FE, the values derived in step No. 1 of this table shall be used.</p> <p>In the case that the interpolation method is applied, intermediate rounding shall be applied according to paragraph 6.1.8. of this Regulation.</p> <p>FC and FE values shall be rounded to three places of decimal.</p> <p>Output is available for vehicles vehicle H and vehicle L and, if applicable, for vehicle M.</p> <p>In the case that the interpolation method is not applied, final rounding shall be applied according to paragraph 6.1.8. of this Regulation.</p> <p>FC and FE values shall be rounded to first place of decimal.</p>	<p>FC_{CS,c}, l/100 km; FC_{CS,p}, l/100 km; FE_{CS,c}, km/l. FE_{CS,p}, km/l.</p>
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Annex B8, paragraph 4.2.1.2.1., Table A8/7, amend the title to read:

"Table A8/7

Calculation of final charge-sustaining fuel consumption **for NOVC-FCHVs and OVC-FCHVs and fuel efficiency for NOVC-FCHV**~~and fuel efficiency for NOVC-FCHVs and OVC-FCHVs~~ **(FE applicable for results after 3 phases only)**

Table A8/7 shall be performed separately for results after 4 phases and for results after 3 phases.

For results after 4-phases all the calculations in this table shall be for the complete cycle

For the 3-phase WLTP all the calculations in this table shall be for the 3-phase cycle and also for individual phases"

Annex B8, paragraph 4.2.1.2.1., Table A8/6, Rows Step No. 5 and Step No. 6, amend to read:

"

<p>5</p> <p>Interpolation family result.</p> <p>If the interpolation method is not applied, step No. 6 is not required and the output of this step is the final result.</p> <p>FC_{CS} results of a Type 1 test for a test vehicle.</p>	<p>Output step 4</p>	<p>FC_{CS,p,4}, kg/100 km; FC_{CS,c,4}, kg/100 km; FC_{CS,c,declared}, kg/100 km. FE_{CS,p,4}, km/kg. FE_{CS,c,4}, km/kg; FE_{CS,c,declared}, km/kg.</p>	<p>Alignment of phase values. Paragraph 1.2.4. of Annex B6, and: FC_{CS,c,5} = FC_{CS,c,declared} FE_{CS,c,5} = FE_{CS,c,declared}</p> <p>FC and FE values shall be rounded according to paragraph 6.1.8. of this Regulation to the second place of decimal.</p> <p>FC shall be rounded to the third place of decimal.</p> <p>FE final rounding shall be to the nearest whole number.</p> <p>In the case that the interpolation method is not applied, final rounding of FC shall be applied according to paragraph 6.1.8. of this Regulation to the first second place of decimal.</p>	<p>FC_{CS,p,5}, kg/100 km; FC_{CS,c,5}, kg/100 km FE_{CS,p,5}, km/kg. FE_{CS,c,5}, km/kg.</p>
<p>6</p> <p>Result of an individual vehicle.</p> <p>Final FC result.</p>	<p>Output step 5</p>	<p>FC_{CS,c,5}, kg/100 km;</p>	<p>Fuel consumption calculation according to paragraph 4.5.5.1.3. of this annex for individual vehicles in an interpolation family.</p> <p>Final rounding of individual vehicle values shall be performed according to paragraph 6.1.8. of this Regulation.</p> <p>FC values shall be rounded to the first second place of decimal.</p> <p>Output is available for each individual vehicle.</p>	<p>FC_{CS,c,ind}, kg/100 km;</p>

"

Annex B8, paragraph 4.2.2., amend to read:

"4.2.2. The charge-depleting fuel consumption **and charge-depleting fuel efficiency** for OVC-HEVs

For 4-phase WLTP test:

The utility factor-weighted charge-depleting fuel consumption FC_{CD} shall be calculated using the following equation:

$$FC_{CD} = \frac{\sum_{j=1}^k (UF_j \times FC_{CD,j})}{\sum_{j=1}^k UF_j}$$

where:

- FC_{CD} is the utility factor weighted charge-depleting fuel consumption, l/100 km in the case of OVC-HEVs and kg/100km in the case of OVC-FCHVs;
- $FC_{CD,j}$ is the fuel consumption for phase j of the charge-depleting Type 1 test, determined according to paragraph 6. of Annex B7, l/100 km in the case of OVC-HEVs and kg/100km in the case of OVC-FCHVs;
- UF_j is the utility factor of phase j according to Appendix 5 to this annex;
- j is the index number for the considered phase;
- k is the number of phases driven up to the end of the transition cycle according to paragraph 3.2.4.4. of this annex.

In the case that the interpolation method is applied, k shall be the number of phases driven up to the end of the transition cycle of vehicle L n_{veh_L} .

If the transition cycle number driven by vehicle H, n_{veh_H} , and, if applicable, by an individual vehicle within the vehicle interpolation family, n_{veh_ind} , is lower than the transition cycle number driven by vehicle L n_{veh_L} the confirmation cycle of vehicle H and, if applicable, an individual vehicle shall be included in the calculation.

The fuel consumption of each phase of the confirmation cycle shall be calculated according to paragraph 6. of Annex B7 with the criteria emission over the complete confirmation cycle and the applicable CO₂ phase value which shall be corrected to an electric energy consumption of zero, $EC_{DC,CD,j} = 0$, by using the CO₂ mass correction coefficient (K_{CO_2}) according to Appendix 2 to this annex.

For 3-phase WLTP test

The charge-depleting fuel efficiency FE_{CD} shall be calculated using the following equation:

$$FE_{CD} = \frac{R_{CDA}}{\sum_{c=1}^{n-1} d_c \times \frac{1}{FE_{CD,c}} + d_n \times \frac{k_{CD}}{FE_{CD,avg,n-1}}}$$

where:

- FE_{CD} is the charge-depleting fuel efficiency, km/l;
- R_{CDA} actual charge-depleting range defined in paragraph 4.4.5. of this annex, km;
- $FE_{CD,c}$ is the fuel efficiency for cycle c of the charge-depleting Type 1 test, determined according to paragraph 6. of Annex B7, km/l;

$$FE_{CD,avg,n-1} = \frac{\sum_{c=1}^{n-1} d_c}{\sum_{c=1}^{n-1} d_c \times \frac{1}{FE_{CD,c}}};$$

- c is the index number for the considered cycle;
- n is the number of applicable WLTP test cycles driven up to the end of the transition cycle according to paragraph 3.2.4.4. of this annex
- d_c is the distance driven in the applicable WLTP test cycle c of the charge-depleting Type 1 test, km;
- d_n is the distance driven in the applicable WLTP test cycle n of the charge-depleting Type 1 test, km;

$$k_{CD} \quad k_{cd} = \frac{M_{CO_2,CS} - M_{CO_2,CD,n}}{M_{CO_2,CS} - M_{CO_2,CD,aveg,n-1}} \quad "$$

Annex B8, paragraph 4.2.3., amend to read:

"4.2.3. This paragraph is applicable only for For 4-phase WLTP test

Utility factor-weighted fuel consumption for OVC-HEVs

The utility factor-weighted fuel consumption for OVC-HEVs from the charge-depleting and charge-sustaining Type 1 test shall be calculated using the following equation:

$$FC_{\text{weighted}} = \sum_{j=1}^k (UF_j \times FC_{CD,j}) \times \frac{M_{CO_2,CD,declared}}{M_{CO_2,CD,ave}} + (1 - \sum_{j=1}^k UF_j) \times FC_{CS}$$

where:

FC_{weighted} is the utility factor-weighted fuel consumption, l/100 km;

UF_j is the utility factor of phase j according to Appendix 5 to this annex;

$FC_{CD,j}$ is the fuel consumption of phase j of the charge-depleting Type 1 test, determined according to paragraph 6. of Annex B7, l/100 km;

$M_{CO_2,CD,declared}$ is the declared charge-depleting CO₂ ~~mass~~ emission according to Table A8/8, step no. 14, g/km;

$M_{CO_2,CD,ave}$ is the **arithmetic** average charge-depleting CO₂ ~~mass~~ emission according to Table A8/8, step no. 13, g/km;

FC_{CS} is the fuel consumption determined according to Table A8/6, step No. 1, l/100 km;

j is the index number for the considered phase;

k is the number of phases driven up to the end of the transition cycle according to paragraph 3.2.4.4. of this annex.

In the case that the interpolation method is applied, k shall be the number of phases driven up to the end of the transition cycle of vehicle L $n_{veh,L}$.

If the transition cycle number driven by vehicle H, $n_{veh,H}$, and, if applicable, by an individual vehicle within the vehicle interpolation family $n_{veh,ind}$ is lower than the transition cycle number driven by vehicle L, $n_{veh,L}$, the confirmation cycle of vehicle H and, if applicable, an individual vehicle shall be included in the calculation.

The fuel consumption of each phase of the confirmation cycle shall be calculated according to paragraph 6. of Annex B7 with the criteria emission over the complete confirmation cycle and the applicable CO₂ phase value which shall be corrected to an electric energy consumption of zero $EC_{DC,CD,j} = 0$ by using the CO₂ mass correction coefficient (K_{CO_2}) according to Appendix 2 to this annex."

Annex B8, paragraph 4.3.4.1., amend to read:

"4.3.4.1. The electric energy consumption determined in this paragraph shall be calculated only if the vehicle was able to follow the applicable **WLTP** test cycle within the speed trace tolerances according to paragraph 2.6.8.3.1.2. of Annex B6 during the entire considered period."

Annex B8, paragraph 4.4.1.1., amend to read:

"4.4.1.1. All-electric range AER

The all-electric range AER for OVC-HEVs shall be determined from the charge-depleting Type 1 test described in paragraph 3.2.4.3. of this annex as part of the Option 1 test sequence and is referenced in paragraph 3.2.6.1. of this annex as part of the Option 3 test sequence by driving the applicable WLTP test cycle according to paragraph 1.4.2.1. of this annex. The AER is defined as the distance driven from the beginning of the charge-depleting Type 1 test to the point in time where the combustion engine or fuel cell in the case of OVC-FCHVs starts consuming fuel."

Annex B8, paragraph 4.4.2.1.1., amend to read:

"4.4.2.1.1. The pure electric range for the applicable WLTP test cycle PER_{WLTC} for PEVs shall be calculated from the shortened Type 1 test as described in paragraph 3.4.4.2. of this annex using the following equations:

$$PER_{WLTC} = \frac{UBE_{STP}}{EC_{DC,WLTC}}$$

where:

PER_{WLTC} is the pure electric range for the applicable WLTC test cycle for PEVs, km;

UBE_{STP} is the usable REESS energy determined from the beginning of the shortened Type 1 test procedure until the break-off criterion as defined in paragraph 3.4.4.2.3. of this annex is reached, Wh;

$EC_{DC,WLTC}$ is the weighted electric energy consumption for the applicable WLTP test cycle of the shortened Type 1 test procedure ~~Test~~, Wh/km;

and

$$UBE_{STP} = \Delta E_{REESS,DS_1} + \Delta E_{REESS,DS_2} + \Delta E_{REESS,CSS_M} + \Delta E_{REESS,CSS_E}$$

where:

$\Delta E_{REESS,DS_1}$ is the electric energy change of all REESSs during DS_1 of the shortened Type 1 test procedure, Wh;

$\Delta E_{REESS,DS_2}$ is the electric energy change of all REESSs during DS_2 of the shortened Type 1 test procedure, Wh;

$\Delta E_{REESS,CSS_M}$ is the electric energy change of all REESSs during CSS_M of the shortened Type 1 test procedure, Wh;

$\Delta E_{REESS,CSS_E}$ is the electric energy change of all REESSs during CSS_E of the shortened Type 1 test procedure, Wh;

and

$$EC_{DC,WLTC} = \sum_{j=1}^2 EC_{DC,WLTC,j} \times K_{WLTC,j}$$

where:

$EC_{DC,WLTC,j}$ is the electric energy consumption for the applicable WLTP test cycle of DS_j of the shortened Type 1 test procedure according to paragraph 4.3. of this annex, Wh/km;

$K_{WLTC,j}$ is the weighting factor for the applicable WLTP test cycle of DS_j of the shortened Type 1 test procedure;

and:

$$K_{WLTC,1} = \frac{\Delta E_{REESS,WLTC,1}}{UBE_{STP}} \text{ and } K_{WLTC,2} = 1 - K_{WLTC,1}$$

where:

- $K_{WLTC,j}$ is the weighting factor for the applicable WLTP test cycle of DS_j of the shortened Type 1 test procedure;
- $\Delta E_{REESS,WLTC,1}$ is the electric energy change of all REESSs during the applicable WLTP test cycle ~~from~~ of DS_1 of the shortened Type 1 test procedure, Wh."

Annex B8, paragraph 4.4.2.2.1., amend to read:

- "4.4.2.2.1. The pure electric range for the applicable WLTP test cycle PER_{WLTP} for PEVs shall be calculated from the Type 1 test as described in paragraph 3.4.4.1. of this annex using the following equations:

$$PER_{WLTC} = \frac{UBE_{CCP}}{EC_{DC,WLTC}}$$

where:

- UBE_{CCP} is the usable REESS energy determined from the beginning of the consecutive cycle Type 1 test procedure until the break-off criterion according to paragraph 3.4.4.1.3. of this annex is reached, Wh;
- $EC_{DC,WLTC}$ is the electric energy consumption for the applicable WLTP test cycle determined from completely driven applicable WLTP test cycles of the consecutive cycle Type 1 test procedure, Wh/km;

and

$$UBE_{CCP} = \sum_{j=1}^k \Delta E_{REESS,j}$$

where:

- $\Delta E_{REESS,j}$ is the electric energy change of all REESSs during phase j of the consecutive cycle Type 1 test procedure, Wh;
- j is the index number of the phase;
- k is the number of phases driven from the beginning up to and including the phase where the break-off criterion is reached;

and:

$$EC_{DC,WLTC} = \sum_{j=1}^{n_{WLTC}} EC_{DC,WLTC,j} \times K_{WLTC,j}$$

where:

- $EC_{DC,WLTC,j}$ is the electric energy consumption for the applicable WLTP test cycle j of the consecutive cycle Type 1 test procedure according to paragraph 4.3. of this annex, Wh/km;
- $K_{WLTC,j}$ is the weighting factor for the applicable WLTP test cycle j of the consecutive cycle Type 1 test procedure;
- j is the index number of the applicable WLTP test cycle;
- n_{WLTC} is the whole number of complete applicable WLTP test cycles driven;

and

$$K_{WLTC,1} = \frac{\Delta E_{REESS,WLTC,1}}{UBE_{CCP}} \text{ and } K_{WLTC,j} = \frac{1 - K_{WLTC,1}}{n_{WLTC} - 1} \text{ for } j = 2 \dots n_{WLTC}$$

where:

- $\Delta E_{REESS,WLTC,1}$ is the electric energy change of all REESSs during the first applicable WLTP test cycle of the consecutive cycle Type 1 test ~~eyele~~ procedure, Wh."

Annex B8, paragraph 4.4.3., amend to read:

"4.4.3. Charge-depleting cycle range for OVC-HEVs

The charge-depleting cycle range R_{CDC} shall be determined from the charge-depleting Type 1 test described in paragraph 3.2.4.3. of this annex as part of the Option 1 test sequence and is referenced in paragraph 3.2.6.1. of this annex as part of the Option 3 test sequence. The R_{CDC} is the distance driven from the beginning of the charge-depleting Type 1 test to the end of the transition cycle according to paragraph 3.2.4.4. of this annex."

Annex B8, paragraph 4.4.4.1., amend to read:

"4.4.4.1. Determination of cycle-specific equivalent all-electric range

The cycle-specific equivalent all-electric range shall be calculated using the following equation:

For 4-phase WLTP test;

$$EAER = \left(\frac{M_{CO_2,CS,declared} - M_{CO_2,CD,avg} \times \frac{M_{CO_2,CD,declared}}{M_{CO_2,CD,ave}}}{M_{CO_2,CS,declared}} \right) \times R_{CDC}$$

For 3-phase WLTP test;

$$EAER = \left(\frac{M_{CO_2,CS,ave} - M_{CO_2,CD,avg}}{M_{CO_2,CS,ave}} \right) \times R_{CDC}$$

where:

EAER	is the cycle-specific equivalent all-electric range, km;
$M_{CO_2,CS,declared}$	is the declared charge-sustaining CO ₂ mass emission according to Table A8/5, step No. 7, g/km;
$M_{CO_2,CD,avg}$	is the arithmetic average charge-depleting CO ₂ mass emission according to the equation below, g/km;
$M_{CO_2,CD,declared}$	is the declared charge-depleting CO ₂ mass emission according to Table A8/8, step no. 14, g/km;
$M_{CO_2,CD,ave}$	is the arithmetic average charge-depleting CO ₂ mass emission according to Table A8/8, step no. 13, g/km;
R_{CDC}	is the charge-depleting cycle range according to paragraph 4.4.2-4.4.3. of this annex, km;
$M_{CO_2,CS,ave}$	is the arithmetic average charge-sustaining CO₂ mass emission according to Table A8/5, step No. 6, g/km;

and

$$M_{CO_2,CD,avg} = \frac{\sum_{j=1}^k (M_{CO_2,CD,j} \times d_j)}{\sum_{j=1}^k d_j}$$

where:

$M_{CO_2,CD,avg}$	is the arithmetic average charge-depleting CO ₂ mass emission, g/km. In the case of more than one charge-depleting test, the additional arithmetic average of each test shall be calculated;
$M_{CO_2,CD,j}$	is the CO ₂ mass emission determined according to paragraph 3.2.1. of Annex B7 of phase j of the charge-depleting Type 1 test, g/km;
d_j	is the distance driven in phase j of the charge-depleting Type 1 test, km;
j	is the index number of the considered phase;

k is the number of phases driven up to the end of the transition cycle n according to paragraph 3.2.4.4. of this annex."

Annex B8, paragraph 4.4.4.2., amend to read:

"4.4.4.2. **This paragraph applies to 4-phase WLTP test only**

Determination of the phase-specific equivalent all-electric range

The phase-specific equivalent all-electric range shall be calculated using the following equation:

$$EAER_p = \left(\frac{M_{CO_2,CS,p} - M_{CO_2,CD,avg,p} \times \frac{M_{CO_2,CD,declared}}{M_{CO_2,CD,ave}}}{M_{CO_2,CS,p}} \right) \times \frac{\sum_{j=1}^k \Delta E_{REESS,j}}{EC_{DC,CD,p}}$$

where:

$EAER_p$ is the phase-specific equivalent all-electric range for the considered phase p, km;

$M_{CO_2,CS,p}$ is the phase-specific CO₂ ~~mass~~ emission from the charge-sustaining Type 1 test for the considered phase p according to Table A8/5, step No. 7, g/km;

$M_{CO_2,CD,declared}$ is the declared charge-depleting CO₂ ~~mass~~ emission according to Table A8/8, step no. 14, g/km;

$M_{CO_2,CD,ave}$ is the **arithmetic** average charge-depleting CO₂ ~~mass~~ emission according to Table A8/8, step no. 13, g/km;

$\Delta E_{REESS,j}$ are the electric energy changes of all REESSs during the considered phase j, Wh. In the case of more than one charge-depleting test, the additional **arithmetic** average of each test shall be calculated;

$EC_{DC,CD,p}$ is the electric energy consumption over the considered phase p based on the REESS depletion, Wh/km;

j is the index number of the considered phase;

k is the number of phases driven up to the end of the transition cycle n according to paragraph 3.2.4.4 of this annex;

and

$$M_{CO_2,CD,avg,p} = \frac{\sum_{c=1}^{n_c} (M_{CO_2,CD,p,c} \times d_{p,c})}{\sum_{c=1}^{n_c} d_{p,c}}$$

where:

$M_{CO_2,CD,avg,p}$ is the arithmetic average charge-depleting CO₂ ~~mass~~ emission for the considered phase p, g/km. In the case of more than one charge-depleting test, the additional **arithmetic** average of each test shall be calculated;

$M_{CO_2,CD,p,c}$ is the CO₂ ~~mass~~ emission determined according to paragraph 3.2.1. of Annex B7 of phase p in cycle c of the charge-depleting Type 1 test, g/km;

$d_{p,c}$ is the distance driven in the considered phase p of cycle c of the charge-depleting Type 1 test, km;

c is the index number of the considered applicable WLTP test cycle;

- p is the index of the individual phase within the applicable WLTP test cycle;
- n_c is the number of applicable WLTP test cycles driven up to the end of the transition cycle n according to paragraph 3.2.4.4. of this annex;

and:

$$EC_{DC,CD,p} = \frac{\sum_{c=1}^{n_c} EC_{DC,CD,p,c} \times d_{p,c}}{\sum_{c=1}^{n_c} d_{p,c}}$$

where:

- $EC_{DC,CD,p}$ is the electric energy consumption of the considered phase p based on the REESS depletion of the charge-depleting Type 1 test, Wh/km. In the case of more than one charge-depleting test, the additional **arithmetic** average of each test shall be calculated;
- $EC_{DC,CD,p,c}$ is the electric energy consumption of the considered phase p of cycle c based on the REESS depletion of the charge-depleting Type 1 test according to paragraph 4.3. of this annex, Wh/km;
- $d_{p,c}$ is the distance driven in the considered phase p of cycle c of the charge-depleting Type 1 test, km;
- c is the index number of the considered applicable WLTP test cycle;
- p is the index of the individual phase within the applicable WLTP test cycle;
- n_c is the number of applicable WLTP test cycles driven up to the end of the transition cycle n according to paragraph 3.2.4.4. of this annex.

~~For the 4 phase WLTP; The considered phase shall be the low phase, medium phase, high phase, extra high phase, and the city driving cycle.~~

~~For the 3 phase WLTP; The considered phase shall be the low phase, medium phase and high phase."~~

Annex B8, paragraph 4.4.5., amend to read:

"4.4.5. Actual charge-depleting range for OVC-HEVs

The actual charge-depleting range shall be calculated using the following equation:

$$R_{CDA} = \sum_{c=1}^{n-1} d_c + \left(\frac{M_{CO_2,CS} - M_{CO_2,n,cycle}}{M_{CO_2,CS} - M_{CO_2,CD,avg,n-1}} \right) \times d_n$$

where:

- R_{CDA} is the actual charge-depleting range, km;
- $M_{CO_2,CS}$ is the charge-sustaining CO₂ mass-emission according to Table A8/5, step No. 7, g/km;
- $M_{CO_2,n,cycle}$ is the CO₂ mass-emission of the applicable WLTP test cycle n of the charge-depleting Type 1 test, g/km;
- $M_{CO_2,CD,avg,n-1}$ is the arithmetic average CO₂ mass-emission of the charge-depleting Type 1 test from the beginning **of the charge-depleting Type 1 test** up to and including the applicable WLTP test cycle (n-1), g/km;

- d_c is the distance driven in the applicable WLTP test cycle c of the charge-depleting Type 1 test, km;
- d_n is the distance driven in the applicable WLTP test cycle n of the charge-depleting Type 1 test, km;
- c is the index number of the considered applicable WLTP test cycle;
- n is the number of applicable WLTP test cycles driven including the transition cycle according to paragraph 3.2.4.4. of this annex;

and:

$$M_{\text{CO}_2,\text{CD,avg},n-1} = \frac{\sum_{c=1}^{n-1} (M_{\text{CO}_2,\text{CD},c} \times d_c)}{\sum_{c=1}^{n-1} d_c}$$

where:

- $M_{\text{CO}_2,\text{CD,avg},n-1}$ is the arithmetic average CO₂ ~~mass~~ emission of the charge-depleting Type 1 test from the beginning of the **charge-depleting Type 1 test** up to and including the applicable WLTP test cycle ($n-1$), g/km;
- $M_{\text{CO}_2,\text{CD},c}$ is the CO₂ ~~mass~~ emission determined according to paragraph 3.2.1. of Annex B7 of the applicable WLTP test cycle c of the charge-depleting Type 1 test, g/km;
- d_c is the distance driven in the applicable WLTP test cycle c of the charge-depleting Type 1 test, km;
- c is the index number of the considered applicable WLTP test cycle;
- n is the number of applicable WLTP test cycles driven including the transition cycle according to paragraph 3.2.4.4. of this annex."

Annex B8, insert a new paragraph 4.4.6., to read:

"4.4.6. (Reserved)"

Annex B8, paragraph 4.5.1.1.2., amend to read:

- "4.5.1.1.2. The maximum difference in charge-sustaining CO₂ **emissions** allowed over the applicable cycle resulting from the calculation of the charge-sustaining CO₂ ~~mass~~ emission $M_{\text{CO}_2,\text{CS}}$ from step 8 in Table A8/5 of Annex B8 between test vehicles L and H shall be 20 per cent"

Annex B8, paragraph 4.5.1.1.4., amend to read:

- "4.5.1.1.4. At the request of the manufacturer and with approval of the responsible authority, the application of the interpolation method on individual vehicle values within a family may be extended if the maximum extrapolation of an individual vehicle (Step 9 in Table A8/5) is not more than 3 g/km above the charge-sustaining CO₂ ~~mass~~ emission of vehicle H (Step 8 in Table A8/5) and/or is not more than 3 g/km below the charge-sustaining CO₂ ~~mass~~ emission of vehicle L (Step 8 in Table A8/5). This extrapolation is valid only within the absolute boundaries of the interpolation range specified in this paragraph.

For the application of a road load matrix family, or when the calculation of the road load of vehicles L and H is based on the default road load, extrapolation is not permitted."

Annex B8, paragraph 4.5.1.1.5., amend to read:

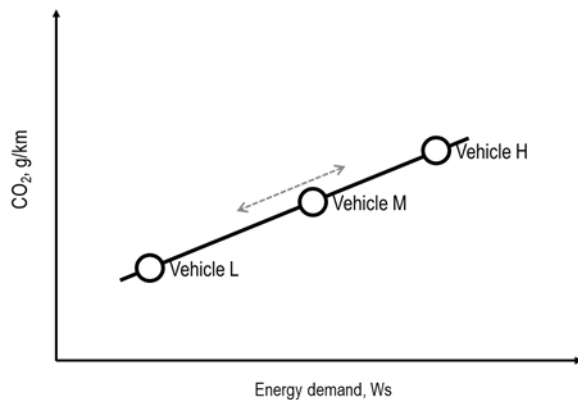
- "4.5.1.1.5. Vehicle M

Vehicle M is a vehicle within the interpolation family between vehicles L and H with a cycle energy demand which is preferably closest to the average of vehicles L and H.

The limits of the selection of vehicle M (see Figure A8/5) are such that neither the difference in CO₂ mass emission between vehicles H and M nor the difference in charge-sustaining CO₂ mass emission between vehicles M and L is higher than the allowed charge-sustaining CO₂ range according to paragraph 4.5.1.1.2. of this annex. The defined road load coefficients and the defined test mass shall be recorded.

Figure A8/5

Limits for the selection of vehicle M



For 4-phase WLTP

The linearity of the corrected measured and averaged charge-sustaining CO₂ mass emission for vehicle M, $M_{CO_2,c,6,M}$ according to step 6 of Table A8/5 of Annex B8, shall be verified against the linearly interpolated charge-sustaining CO₂ mass emission between vehicles L and H over the applicable cycle by using the corrected measured and averaged charge-sustaining CO₂ mass emission $M_{CO_2,c,6,H}$ of vehicle H and $M_{CO_2,c,6,L}$ of vehicle L, according to step 6 of Table A8/5 of Annex B8, for the linear CO₂ mass emission interpolation.

For 3-phase WLTP

An additional averaging of tests using the charge-sustaining CO₂-output of step 4a is necessary (not described in Table A8/5). The linearity of the corrected measured and averaged charge-sustaining CO₂ mass emission for vehicle M, $M_{CO_2,c,4a,M}$ according to step 4a of Table A8/5 of Annex B8, shall be verified against the linearly interpolated CO₂ mass emission between vehicles L and H over the applicable cycle by using the corrected measured and averaged charge-sustaining CO₂ mass emission $M_{CO_2,c,4a,H}$ of vehicle H and $M_{CO_2,c,4a,L}$ of vehicle L, according to step 4a used in of Table A8/5 of Annex B8, for the linear CO₂ mass emission interpolation.

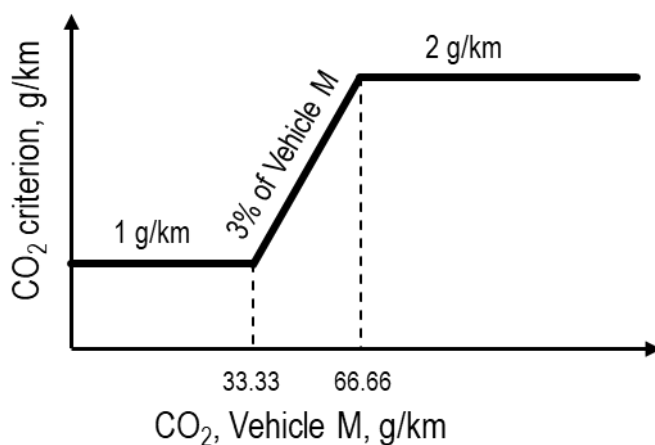
For 3-phase and 4-phase WLTP

The linearity criterion for vehicle M shall be considered fulfilled if the charge-sustaining CO₂ mass emission of vehicle M over the applicable WLTC minus the charge-sustaining CO₂ mass emission derived by interpolation is less than 2 g/km or 3 per cent of the interpolated value, whichever value is less, but at least 1 g/km. See Figure A8/6.

Figure A8/6

Linearity criterion for vehicle M

Tolerance, Vehicle M measured vs. calculated



If the linearity criterion is fulfilled, the interpolation method shall be applicable for all individual vehicle values between vehicles L and H within the interpolation family.

If the linearity criterion is not fulfilled, the interpolation family shall be split into two sub-families for vehicles with a cycle energy demand between vehicles L and M, and vehicles with a cycle energy demand between vehicles M and H. In such a case, the final values of e.g. the charge-sustaining CO₂ mass-emissions of vehicle M shall be determined according to the same process as for vehicles L or H. See Table A8/5, Table A8/6, Table A8/8 and Table A8/9.

For vehicles with a cycle energy demand between that of vehicles L and M, each parameter of vehicle H necessary for the application of the interpolation method on individual OVC-HEV and NOVC-HEV values, shall be substituted by the corresponding parameter of vehicle M.

For vehicles with a cycle energy demand between that of vehicles M and H, each parameter of vehicle L that is necessary for the application of the interpolation method on individual OVC-HEV and NOVC-HEV values shall be substituted by the corresponding parameter of vehicle M. "

Annex B8, paragraph 4.5.2., amend to read:

"4.5.2. Calculation of energy demand per period

The energy demand $E_{k,p}$ and distance driven $d_{c,p}$ per period p applicable for individual vehicles in the interpolation family shall be calculated according to the procedure in paragraph 5. of Annex B7, for the sets k of road load coefficients and masses according to paragraph 3.2.3.2.3. of Annex B7."

Annex B8, paragraph 4.5.4., amend to read:

"4.5.4. This paragraph is applicable only for 4-phase WLTP test

Interpolation of the CO₂ mass emission for individual vehicles"

Annex B8, paragraph 4.5.4.1., amend to read:

"4.5.4.1. Individual charge-sustaining CO₂ mass-emission for OVC-HEVs and NOVC-HEVs

The charge-sustaining CO₂ mass-emission for an individual vehicle shall be calculated using the following equation:

$$M_{\text{CO}_2\text{-ind,CS,p}} = M_{\text{CO}_2\text{-L,CS,p}} + K_{\text{ind,p}} \times (M_{\text{CO}_2\text{-H,CS,p}} - M_{\text{CO}_2\text{-L,CS,p}})$$

where:

$M_{\text{CO}_2\text{-ind,CS,p}}$ is the charge-sustaining CO₂ ~~mass~~-emission for an individual vehicle of the considered period p according to Table A8/5, step No. 9, g/km;

$M_{\text{CO}_2\text{-L,CS,p}}$ is the charge-sustaining CO₂ ~~mass~~-emission for vehicle L of the considered period p according to Table A8/5, step No. 8, g/km;

$M_{\text{CO}_2\text{-H,CS,p}}$ is the charge-sustaining CO₂ ~~mass~~-emission for vehicle H of the considered period p according to Table A8/5, step No. 8, g/km;

$K_{\text{ind,p}}$ is the interpolation coefficient for the considered individual vehicle for period p;

p is the index of the individual period within the applicable WLTP test cycle.

The considered periods shall be the low phase, medium phase, high phase, extra high phase and the applicable WLTP test cycle."

Annex B8, paragraph 4.5.4.2., amend to read:

"4.5.4.2. Individual utility factor-weighted charge-depleting CO₂ ~~mass~~-emission for OVC-HEVs

The utility factor-weighted charge-depleting CO₂ ~~mass~~-emission for an individual vehicle shall be calculated using the following equation:

$$M_{\text{CO}_2\text{-ind,CD}} = M_{\text{CO}_2\text{-L,CD}} + K_{\text{ind}} \times (M_{\text{CO}_2\text{-H,CD}} - M_{\text{CO}_2\text{-L,CD}})$$

where:

$M_{\text{CO}_2\text{-ind,CD}}$ is the utility factor-weighted charge-depleting CO₂ ~~mass~~ emission for an individual vehicle, g/km;

$M_{\text{CO}_2\text{-L,CD}}$ is the utility factor-weighted charge-depleting CO₂ ~~mass~~ emission for vehicle L, g/km;

$M_{\text{CO}_2\text{-H,CD}}$ is the utility factor-weighted charge-depleting CO₂ ~~mass~~ emission for vehicle H, g/km;

K_{ind} is the interpolation coefficient for the considered individual vehicle for the applicable WLTP test cycle."

Annex B8, paragraph 4.5.4.3., amend to read:

"4.5.4.3. Individual utility factor-weighted CO₂ ~~mass~~ emission for OVC-HEVs

The utility factor-weighted CO₂ ~~mass~~ emission for an individual vehicle shall be calculated using the following equation:

$$M_{\text{CO}_2\text{-ind,weighted}} = M_{\text{CO}_2\text{-L,weighted}} + K_{\text{ind}} \times (M_{\text{CO}_2\text{-H,weighted}} - M_{\text{CO}_2\text{-L,weighted}})$$

where:

$M_{\text{CO}_2\text{-ind,weighted}}$ is the utility factor-weighted CO₂ ~~mass~~-emission for an individual vehicle, g/km;

$M_{\text{CO}_2\text{-L,weighted}}$ is the utility factor-weighted CO₂ ~~mass~~-emission for vehicle L, g/km;

$M_{\text{CO}_2\text{-H,weighted}}$ is the utility factor-weighted CO₂ ~~mass~~-emission for vehicle H, g/km;

K_{ind} is the interpolation coefficient for the considered individual vehicle for the applicable WLTP test cycle."

Annex B8, paragraph 4.5.5.2., amend to read:

"4.5.5.2. Individual ~~charge~~ **charge-depleting** fuel consumption for OVC-HEVs and OVC-FCHVs **and individual charge-depleting fuel efficiency for OVC-HEVs.**

For 4-phase WLTP test

The utility factor-weighted"

Annex B8, paragraph 4.5.7.1., amend to read:

"4.5.7.1."

If the criterion defined in this paragraph is not fulfilled, the AER determined for vehicle H is applicable to all vehicles within the interpolation family.

For the 4-phase WLTP; The considered periods shall be the applicable WLTP city test cycle and the applicable WLTP test cycle.

For the 3-phase WLTP; The considered periods shall be the applicable WLTP test cycle.

~~If the criterion defined in this paragraph is not fulfilled, the AER determined for vehicle H is applicable to all vehicles within the interpolation family."~~

Annex B8, paragraph 4.6.1., amend to read:

"4.6.1. Stepwise procedure for calculating the final test results of the charge-depleting Type 1 test for OVC-HEVs

The results shall be calculated in the order described in Table A8/8. All applicable results in the column "Output" shall be recorded. The column "Process" describes the paragraphs to be used for calculation or contains additional calculations.

For the purpose of ~~Table A8/8~~ **this table**, the following nomenclature within the equations and results is used:

- c complete applicable test cycle;
- p every applicable cycle phase; for the purpose of EAER_{city} calculation (as applicable), p shall represent the city driving cycle;
- i applicable criteria emission component;
- CS charge-sustaining;
- CO₂ CO₂ ~~mass~~-emission.

Table A8/8
Calculation of final charge-depleting values (FE applicable for results after 3 phases only)

Step no.	Source	Input	Process	Output
1	Annex B8	Charge-depleting test results	<p>Results measured according to Appendix 3 to this annex, pre-calculated according to paragraph 4.3. of this annex.</p> <p>Recharged electric energy according to paragraph 3.2.4.6. of this annex.</p> <p>Cycle energy according to paragraph 5. of Annex B7.</p>	<p>$\Delta E_{REESS,j}$, Wh; d_j, km;</p> <p>E_{AC}, Wh;</p> <p>E_{cycle}, WS;</p>

Step no.	Source	Input	Process	Output
			<p>CO₂ mass-emission according to paragraph 3.2.1. of Annex B7.</p> <p>Mass of gaseous emission compound $M_{i,CD,j}$ according to paragraph 4.1.3.1. of Annex B8.</p> <p>All-electric range determined according to paragraph 4.4.1.1. of this annex.</p> <p>CO₂ mass-emission K_{CO_2} correction coefficient might be necessary according to Appendix 2 to this annex.</p> <p>Output is available for each test.</p> <p>In the case that the interpolation method is applied, the output (except of K_{CO_2}) is available for vehicle H, L and, if applicable, M.</p>	<p>$M_{CO_2,CD,j}$, g/km;</p> <p>$M_{i,CD,j}$, g/km;</p> <p>AER, km;</p> <p>K_{CO_2}, (g/km)/(Wh/km).</p>
	For results after 4 phases Annex B8		<p>Usable battery energy according to paragraph 4.4.1.2.2. of this annex.</p> <p>In the case that the applicable WLTC city test cycle was driven: all-electric range city according to paragraph 4.4.1.2.1. of this annex.</p> <p>Particle number emissions (if applicable) according to paragraph 4. of Annex B7.</p> <p>Particulate matter emissions according to paragraph 4. of Annex B7.</p>	<p>UBE_{city}, Wh;</p> <p>AER_{city}, km.</p> <p>$PN_{CD,j}$, particles per kilometer;</p> <p>$PM_{CD,c}$, mg/km;</p>
2	Output step 1	$\Delta E_{REESS,j}$, Wh; E_{cycle} , Wh.	<p>Calculation of relative electric energy change for each cycle according to paragraph 3.2.4.5.2. of this annex.</p> <p>Output is available for each test and each applicable WLTP test cycle.</p> <p>In the case that the interpolation method is applied, the output is available for vehicle H, L and, if applicable, M.</p>	$REEC_i$.
3	Output step 2	$REEC_i$.	Determination of the transition and confirmation cycle according to paragraph 3.2.4.4. of this annex.	n_{veh} ;

Step no.	Source	Input	Process	Output
			<p>In the case that more than one charge-depleting test is available for one vehicle configuration, for the purpose of averaging, each test shall have the same transition cycle number n_{veh}.</p> <p>Determination of the charge-depleting cycle range according to paragraph 4.4.3. of this annex.</p> <p>Output is available for each test.</p> <p>In the case that the interpolation method is applied, the output is available for vehicle H, L and, if applicable, M.</p>	R_{CDC} ; km.
4	Output step 3	n_{veh} ;	<p>In the case that the interpolation method is used, the transition cycle shall be determined for vehicle H, L and, if applicable, M.</p> <p>Check whether the interpolation criterion according to paragraph 6.3.2.2. (d) of this Regulation is fulfilled.</p>	$n_{veh,L}$; $n_{veh,H}$; if applicable $n_{veh,M}$.
For results after 4 phases 5	Output step 1	$M_{i,CD,j}$, g/km; $PM_{CD,c}$, mg/km; $PN_{CD,j}$, particles per kilometer.	<p>Calculation of combined values for emissions for n_{veh} cycles; in the case that the interpolation method is applied, $n_{veh,L}$ cycles shall be used for $n_{veh,H}$ cycles and $n_{veh,M}$ cycles, if applicable.in the case of interpolation for $n_{veh,L}$ cycles for each vehicle.</p> <p>Output is available for each test.</p> <p>In the case that the interpolation method is applied, the output is available for vehicle H, L and, if applicable, M.</p>	$M_{i,CD,c}$, g/km; $PM_{CD,c}$, mg/km; $PN_{CD,c}$, particles per kilometer.
For results after 4 phases 6	Output step 5	$M_{i,CD,c}$, g/km; $PM_{CD,c}$, mg/km; $PN_{CD,c}$, particles per kilometer.	Emission averaging of tests for each applicable WLTP test cycle within the charge-depleting Type 1 test and checking compliance with the limits according to Table A6/2 of Annex B6.	$M_{i,CD,c,ave}$, g/km; $PM_{CD,c,ave}$, mg/km; $PN_{CD,c,ave}$, particles per kilometer.
For results after 4 phases 7	Output step 1	$\Delta E_{REESS,j}$, Wh; d_j , km; UBE_{city} , Wh.	<p>In the case that AER_{city} is derived from the Type 1 test by driving the applicable WLTP test cycles, the value shall be calculated according to paragraph 4.4.1.2.2. of this annex.</p> <p>In the case of more than one test, $n_{city,pe}$ shall be equal for each test.</p> <p>Output is available for each test.</p>	AER_{city} , km; $AER_{city,ave}$, km.

Step no.	Source	Input	Process	Output
			Averaging of AER_{city} . In the case that the interpolation method is applied, the output is available for vehicle H, L and, if applicable, M.	
For results after 4 phases 8	Output step 1	d_j , km;	Phase-specific and cycle-specific UF calculation.	$UF_{phase,j}$; $UF_{cycle,c}$.
	Output step 3	n_{veh} ;	Output is available for each test.	
	Output step 4	$n_{veh,L}$;	In the case that the interpolation method is applied, the output is available for vehicle H, L and, if applicable, M.	
For results after 4 phases 9	Output step 1	$\Delta E_{REESS,j}$, Wh; d_j , km; E_{AC} , Wh;	Calculation of the electric energy consumption based on the recharged energy according to paragraphs 4.3.1. of this annex.	$EC_{AC,CD}$, Wh/km;
	Output step 3	n_{veh} ;	In the case of interpolation, $n_{veh,L}$ cycles shall be used. Therefore, due to the required correction of the CO_2 mass-emission, the electric energy consumption of the confirmation cycle and its phases shall be set to zero.	
	Output step 4	$n_{veh,L}$;	Output is available for each test.	
	Output step 8	$UF_{phase,j}$;	In the case that the interpolation method is applied, the output is available for vehicle H, L and, if applicable, M.	
10	Output step 1	$M_{CO_2,CD,j}$, g/km; K_{CO_2} , (g/km)/(Wh/km); $\Delta E_{REESS,j}$, Wh; d_j , km; n_{veh} ; $n_{veh,L}$; $UF_{phase,j}$.	Calculation of the charge-depleting CO_2 mass-emission according to paragraph 4.1.2. of this annex. In the case that the interpolation method is applied, $n_{veh,L}$ cycles shall be used. With reference to paragraph 4.1.2. of this annex, the confirmation cycle shall be corrected according to Appendix 2 to this annex.	$M_{CO_2,CD}$, g/km;
	Output step 3	d_j , km;	Output is available for each test.	
	Output step 4	n_{veh} ;		
	Output step 8	$n_{veh,L}$; $UF_{phase,j}$.	In the case that the interpolation method is applied, the output is available for vehicle H, L and, if applicable, M.	
11	Output step 1	$M_{CO_2,CD,j}$, g/km; $M_{i,CD,j}$, g/km; K_{CO_2} , (g/km)/(Wh/km).	Calculation of the charge-depleting fuel consumption and fuel efficiency according to paragraph 4.2.2. of this annex.	For results after 4 phases, $FC_{CD,j}$, l/100 km; FC_{CD} , l/100 km.

Step no.	Source	Input	Process	Output
		n_{veh} ; $n_{veh,L}$; $UF_{phase,j}$;	In the case that the interpolation method is applied, $n_{veh,L}$ cycles shall be used. With reference to paragraph 4.1.2. of this annex, $M_{CO_2,CD,j}$ of the confirmation cycle shall be corrected according to Appendix 2 to this annex.	For results after 3 phases, FE_{CD} , km/l.
	Output step 3	n_{veh} ;		
	Output step 4	$n_{veh,L}$;		
	Output step 8	$UF_{phase,j}$;	For results after 4 phases, the phase-specific fuel consumption $FC_{CD,j}$ shall be calculated using the corrected CO ₂ mass-emission according to paragraph 6. of Annex B7. Output is available for each test. In the case that the interpolation method is applied, the output is available for vehicle H, L and, if applicable, M.	
12	Output step 1	$\Delta E_{REESS,j}$, Wh; d_j , km;	If applicable, calculation of the electric energy consumption from the first applicable WLTP test cycle as described in Paragraph 2.2. of Appendix 8, Paragraph 2.1. to this annex. Output is available for each test. In the case that the interpolation method is applied, the output is available for vehicle H, L and, if applicable, M.	$EC_{DC,CD,first}$, Wh/km
13	Output step 9	$EC_{AC,CD}$, Wh/km;	Averaging of tests for each vehicle.	If applicable: $EC_{DC,CD,first,ave}$, Wh/km
	Output step 10	$M_{CO_2,CD}$, g/km;	In the case that the interpolation method is applied, the output is available for each vehicle H, L and, if applicable, M.	For results after 4 phases, $EC_{AC,CD,ave}$, Wh/km;
	Output step 11	FC_{CD} , l/100 km; FE_{CD} , km/l.		$M_{CO_2,CD,ave}$, g/km;
	Output step 12	If applicable: $EC_{DC,CD,first}$, Wh/km.		$FC_{CD,ave}$, l/100 km; For results after 3 phases, $FE_{CD,ave}$, km/l.
14	Output step 13	$EC_{AC,CD,ave}$, Wh/km; $M_{CO_2,CD,ave}$, g/km. $FE_{CD,ave}$, km/l.	Declaration of charge-depleting electric energy consumption, fuel efficiency and CO ₂ mass-emission for each vehicle. Calculation of $EC_{AC,weighted}$ according to paragraph 4.3.2. of this annex. In the case that the interpolation method is applied, the output is	For results after 4 phases, $EC_{AC,CD,declared}$, Wh/km; $EC_{AC,weighted}$, Wh/km; $M_{CO_2,CD,declared}$, g/km. For results after 3 phases, $FE_{CD,declared}$, km/l.

<i>Step no.</i>	<i>Source</i>	<i>Input</i>	<i>Process</i>	<i>Output</i>
			available for each vehicle H, L and, if applicable, M.	
15	Output step 13	$EC_{AC,CD,ave}$, Wh/km; If applicable: $EC_{DC,CD,first,ave}$, Wh/km;	If applicable: Adjustment of electric energy consumption for the purpose of COP as described in paragraph 2.2. of Appendix 8, paragraph 2.1. to this annex. In the case that the interpolation method is applied, the output is available for each vehicle H, L and, if applicable, M.	$EC_{DC,CD,COP}$, Wh/km;
	Output step 14	$EC_{AC,CD,declared}$, Wh/km;		

Step no.	Source	Input	Process	Output
16 Interpolation family result. If the interpolation method is not applied, step No. 17 is not required and the output of this step is the final result.	Output step 15	If applicable: EC _{DC,CD,COP} , Wh/km;	In the case that the interpolation method is applied, intermediate rounding shall be performed according to paragraph 6.1.8. of this Regulation: M _{CO2,CD} shall be rounded to the second place of decimal. EC _{AC,CD,final} and EC _{AC,weighted,final} shall be rounded to the first place of decimal. If applicable: EC _{DC,CD,COP} shall be rounded to the first place of decimal. FC _{CD} and FE _{CD} shall be rounded to the third place of decimal. Output is available for vehicles vehicle H and for vehicle L and, if applicable, for vehicle M. In case that the interpolation method is not applied, final rounding shall be applied according to paragraph 6.1.8. of this Regulation: EC _{AC,CD} , EC _{AC,weighted} and M _{CO2,CD} shall be rounded to the nearest whole number. If applicable: EC _{DC,CD,COP} shall be rounded to the nearest whole number. FC _{CD} and FE _{CD} shall be rounded to the first place of decimal.	If applicable: EC _{DC,CD,COP,final} , Wh/km;
	Output step 14	EC _{AC,CD,declared} , Wh/km; EC _{AC,weighted} , Wh/km; FE _{CD,declared} , km/l; M _{CO2,CD,declared} , g/km.		For results after 4 phases, EC _{AC,CD,final} , Wh/km; M _{CO2,CD,final} , g/km; EC _{AC,weighted,final} , Wh/km; FC _{CD,final} , l/100 km;
	Output step 13	FC _{CD,ave} , l/100 km;		For results after 3 phases, FE _{CD,final} , km/l;
17 Result of an individual vehicle. Final test result.	Output step 16	If applicable: EC _{DC,CD,COP,final} , Wh/km; EC _{AC,CD,final} , Wh/km; M _{CO2,CD,final} , g/km; EC _{AC,weighted,final} , Wh/km; FC _{CD,final} , l/100 km; FE _{CD,final} , km/l;	Interpolation of individual values based on input from vehicles H and L and, if applicable, vehicle M. Final rounding of individual vehicle values shall be performed according to paragraph 6.1.8. of this Regulation. EC _{AC,CD} , EC _{AC,weighted} and M _{CO2,CD} shall be rounded to the nearest whole number. If applicable: EC _{DC,CD,COP} shall be rounded to the nearest whole number.	If applicable: EC _{DC,CD,COP,ind} , Wh/km; For results after 4 phases, EC _{AC,CD,ind} , Wh/km; M _{CO2,CD,ind} , g/km; EC _{AC,weighted,ind} , Wh/km; FC _{CD,ind} , l/100 km; For results after 3 phases, FE _{CD,ind} , km/l;

Step no.	Source	Input	Process	Output
			FC _{CD} shall be rounded to the first place of decimal. Output is available for each individual vehicle.	

Annex B8, paragraph 4.6.2., amend to read:

"4.6.2. Stepwise procedure for calculating the final charge-sustaining and charge-depleting weighted test results of the Type 1 test for OVC-HEVs

The results shall be calculated in the order described in Table A8/9. All applicable results in the column "Output" shall be recorded. The column "Process" describes the paragraphs to be used for calculation or contains additional calculations.

For the purpose of this table, the following nomenclature within the equations and results is used:

- c considered period is the complete applicable test cycle;
- p every applicable cycle phase; for the purpose of EAER_{city} calculation (as applicable), p shall represent the city driving cycle;
- i applicable criteria emission component (except for CO₂);
- j index for the considered period;
- CS charge-sustaining;
- CD charge-depleting;
- CO₂ CO₂ mass-emission;
- REESS Rechargeable Electric Energy Storage System.

Table A8/9

Calculation of final charge-depleting and charge-sustaining weighted values (FE applicable for results after 3 phases only)

Step no.	Source	Input	Process	Output
1	Output step 1, Table A8/8 Output step 7, Table A8/8 Output step 3, Table A8/8 Output step 4, Table A8/8	M _{i,CD,j} , g/km; PN _{CD,j} , particles per kilometer; PM _{CD,c} , mg/km; M _{CO2,CD,j} , g/km; ΔE _{REESS,j} , Wh; d _j , km; AER, km; E _{AC} , Wh; AER _{city,ave} , km; n _{veh} ; R _{CDC} , km; n _{veh,L} ; n _{veh,H} ;	Input from CD and CS post processing.	M _{CO2,CD,j} , g/km; AER, km; E _{AC} , Wh; M _{CO2,CS,declared} , g/km; M _{CO2,CD,declared} , g/km; M _{CO2,CD,ave} , g/km; For results after 4 phases M _{i,CD,j} , g/km; PN _{CD,j} , particles per kilometer; PM _{CD,c} , mg/km; ΔE _{REESS,j} , Wh; d _j , km; AER _{city,ave} , km; n _{veh} ; R _{CDC} , km; n _{veh,L} ;

Step no.	Source	Input	Process	Output
	Output step 8, Table A8/8 Output step 6, Table A8/5 Output step 7, Table A8/5 Output step 14, Table A8/8 Output step 13, Table A8/8	UF _{phase,j} ; UF _{cycle,c} ; M _{i,CS,c,6} , g/km; M _{CO2,CS,declared} , g/km; M _{CO2,CS,p} M _{CO2,CD,declared} , g/km; M _{CO2,CD,ave} , g/km; K _{CO2} , (g/km)/(Wh/km).	Output in the case of CD is available for each CD test. Output in the case of CS is available once due to CS test averaged values. In the case that the interpolation method is applied, the output (except of K _{CO2}) is available for vehicle H, L and, if applicable, M. CO ₂ mass-emission correction coefficient K _{CO2} might be necessary according to Appendix 2 to this annex.	n _{veh,H} ; UF _{phase,j} ; UF _{cycle,c} ; M _{i,CS,c,6} , g/km; M _{CO2,CS,p} K _{CO2} , (g/km)/(Wh/km).
For results after 4 phases 2	Output step 1	M _{i,CD,j} , g/km; PN _{CD,j} , particles per kilometer; PM _{CD,c} , mg/km; n _{veh} ; n _{veh,L} ; UF _{phase,j} ; UF _{cycle,c} ; M _{i,CS,c,6} , g/km;	Calculation of weighted emission (except M _{CO2,weighted}) compounds according to paragraphs 4.1.3.1. to 4.1.3.3. inclusive of this annex. Remark: M _{i,CS,c,6} includes PN _{CS,c} and PM _{CS,c} . Output is available for each CD test. In the case that the interpolation method is applied, the output is available for each vehicle L, H and, if applicable, M.	M _{i,weighted} , g/km; PN _{weighted} , particles per kilometer; PM _{weighted} , mg/km;
3	Output step 1	M _{CO2,CD,j} , g/km; ΔE _{REESS,j} , Wh; d _j , km; n _{veh} ; R _{CDC} , km M _{CO2,CS,declared} , g/km; M _{CO2,CS,p}	Calculation of equivalent all-electric range according to paragraphs 4.4.4.1. and 4.4.4.2. of this annex, and actual charge-depleting range according to paragraph 4.4.5. of this annex. Output is available for each CD test. R _{CDA} shall be rounded according to paragraph 6.1.8. of this Regulation to the nearest whole number. In the case that the interpolation method is applied, the output is available for each vehicle L, H and, if applicable, M.	EAER, km; EAER _p , km; R _{CDA} , km.

<i>Step no.</i>	<i>Source</i>	<i>Input</i>	<i>Process</i>	<i>Output</i>
4	Output step 1 Output step 3	AER, km; R _{CDA} , km.	Output is available for each CD test. In the case that the interpolation method is applied, check the availability of AER interpolation between vehicle H, L and, if applicable, M according to paragraph 4.5.7.1. of this annex. If the interpolation method is used, each test shall fulfil the requirement.	AER-interpolation availability.
5	Output step 1	AER, km.	Averaging AER and AER declaration. The declared AER shall be rounded according to paragraph 6.1.8. of this Regulation to the number of decimal places specified in Table A6/1 of Annex B6. In the case that the interpolation method is applied and the AER interpolation availability criterion is fulfilled, AER shall be rounded according to paragraph 6.1.8. of this Regulation to the first place of decimal. The output is available for each vehicles H and L and, if applicable, for vehicle M. If the case that the interpolation method is applied but the criterion is not fulfilled, AER of vehicle H shall be applied for the whole interpolation family and shall be rounded according to paragraph 6.1.8. of this Regulation to the nearest whole number. In the case that the interpolation method is not applied, AER shall be rounded according to paragraph 6.1.8. of this Regulation to the nearest whole number.	AER _{ave} , km; For results after 4 phases AER _{dec} , km.
			<p>Interpolation family result.</p> <p>If the interpolation method is not applied, step No. 9 is not required and the output of this step is the final result.</p>	

Step no.	Source	Input	Process	Output
For results after 4 phases, 6	Output step 1	$M_{i,CD,j}$, g/km; $M_{CO_2,CD,j}$, g/km; n_{veh} ; $n_{veh,L}$; $UF_{phase,j}$; $M_{i,CS,c,6}$, g/km; $M_{CO_2,CS,declared}$, g/km. $M_{CO_2,CD,declared}$, g/km; $M_{CO_2,CD,ave}$, g/km;	<p>Calculation of weighted CO₂ mass emission and fuel consumption according to paragraphs 4.1.3.1. and 4.2.3. of this annex.</p> <p>Output is available for each CD test.</p> <p>In the case that the interpolation method is applied, $n_{veh,L}$ cycles shall be used. With reference to paragraph 4.1.2. of this annex, $M_{CO_2,CD,j}$ of the confirmation cycle shall be corrected according to Appendix 2 to this annex.</p> <p>In the case that the interpolation method is applied, the output is available for each vehicle H, vehicle L and, if applicable, vehicle M.</p>	$M_{CO_2,weighted}$, g/km; $FC_{weighted}$, l/100 km;
7	Output step 1	E_{AC} , Wh;	<p>Calculation of the electric energy consumption based on EAER according to paragraphs 4.3.3.1. and 4.3.3.2. of this annex.</p> <p>Output is available for each CD test.</p> <p>In the case that the interpolation method is applied, the output is available for each vehicle H, vehicle L and, if applicable, vehicle M.</p>	EC , Wh/km; EC_p , Wh/km;
	Output step 3	$EAER$, km; $EAER_p$, km;		
8	Output step 1	$AER_{city, ave}$, km;	For results after 3 phases Averaging EC and EC declaration.	For results after 3 phases
Interpolation family result. If the interpolation method is not applied, step No. 9 is not required and the output of	Output step 6	$M_{CO_2,weighted}$, g/km; $FC_{weighted}$, l/100 km;	$EC_{p,final} = EC_{p,ave} \times \frac{EC_{dec}}{EC_{ave}}$	EC_{dec} , Wh/km; $EC_{p,final}$, Wh/km; $EAER_{final}$, km;
	Output step 7	EC , Wh/km; EC_p , Wh/km;		For results after 4 phases
	Output step 3	$EAER$, km; $EAER_p$, km;	Averaging and intermediate rounding according to paragraph 6.1.8. of this Regulation.	For results after 4 phases $AER_{city,final}$, km; $M_{CO_2,weighted,final}$, g/km; $FC_{weighted,final}$, l/100 km;

Step no.	Source	Input	Process	Output
this step is the final result.	Output step 5	AER _{dec} , km; AER _{ave} , km.-	<p>In the case that the interpolation method is applied, intermediate rounding shall be performed according to paragraph 6.1.8. of this Regulation.</p> $AER_{city,final} = AER_{city,ave} \times \frac{AER_{dec}}{AER_{ave}}$ <p>AER_{city,ave}, EAER and EAER_p shall be rounded to the first place of decimal.</p> <p>M_{CO2,weighted} shall be rounded to the second place of decimal.</p> <p>FC_{weighted} shall be rounded to the third place of decimal.</p> <p>EC and EC_p shall be rounded to the first place of decimal.</p> <p>The output is available for each vehicle H, vehicle L and, if applicable, vehicle M.</p> <p>In case that the interpolation method is not applied, final rounding of the test results shall be applied according to paragraph 6.1.8. of this Regulation.</p> <p>AER_{city,ave} AER_{city,final}, EAER and EAER_p shall be rounded to the nearest whole number.</p> <p>M_{CO2,weighted} shall be rounded to the nearest whole number.</p> <p>FC_{weighted} shall be rounded to the first place of decimal.</p> <p>EC and EC_p shall be rounded to the nearest whole number.</p>	EC _{final} , Wh/km; EC _{p,final} , Wh/km; EAER _{final} , km; EAER _{p,final} , km.

<i>Step no.</i>	<i>Source</i>	<i>Input</i>	<i>Process</i>	<i>Output</i>
9	Output step 5	AER _{dec} , km;	<p>Interpolation of individual values based on input from vehicle low, medium and high according to paragraph 4.5. of this annex, and final rounding according to paragraph 6.1.8. of this Regulation.</p> <p>AER_{ind}, AER_{city,ind}, EAER_{ind} and EAER_{p,ind} shall be rounded to the nearest whole number.</p> <p>M_{CO2,weighted,ind} shall be rounded to the nearest whole number.</p> <p>EC_{weighted,ind} shall be rounded to the first place of decimal.</p> <p>FC_{weighted,ind} shall be rounded to the first place of decimal.</p> <p>EC_{ind} and EC_{p,ind} shall be rounded to the nearest whole number.</p> <p>Output is available for each individual vehicles.</p> <p>R_{CDC} shall be rounded according to paragraph 6.1.8. of this Regulation to the nearest whole number.</p>	EC _{ind} , Wh/km; EC _{p,ind} , Wh/km; EAER _{ind} , km;
Result of an individual vehicle. Final test result.	Output step 8	AER _{city,final} , km; M _{CO2,weighted,final} , g/km; FC _{weighted,final} , l/100 km; EC _{final} , Wh/km; EC _{p,final} , Wh/km; EAER _{final} , km; EAER _{p,final} , km;		For results after 4 phases, AER _{ind} , km; AER _{city,ind} , km; M _{CO2,weighted,ind} , g/km; FC _{weighted,ind} , l/100 km; EAER _{p,ind} , km.
	Output step 4	AER-interpolation availability		
	Output step 1	R _{CDC}		R _{CDC,final}

"

Annex B8, paragraph 4.7.1., Table A8/10, Rows Step no. 1, Step no. 2, Step no. 3, Step no. 4, Step no. 5, Step no. 6, Step no.7 and Step no. 8, amend to read:

"

Step no.	Source	Input	Process	Output
1	Annex B8	Test results	<p>Results measured according to Appendix 3 to this annex and pre-calculated according to paragraph 4.3. of this annex.</p> <p>Usable battery energy according to paragraph 4.4.2.2.1. of this annex.</p> <p>Recharged electric energy according to paragraph 3.4.4.3. of this annex.</p> <p>Output is available for each test.</p> <p>E_{AC} shall be rounded according to paragraph 6.1.8. of this Regulation to the first place of decimal. In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.</p>	<p>$\Delta E_{REESS,j}$, Wh; d_j, km;</p> <p>UBE_{CCP}, Wh;</p> <p>E_{AC}, Wh.</p>
2	Output step 1	$\Delta E_{REESS,j}$, Wh; UBE_{CCP} , Wh.	<p>Determination of the number of completely driven applicable WLTC phases and cycles according to paragraph 4.4.2.2. of this annex.</p> <p>Output is available for each test.</p> <p>In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.</p>	<p>n_{WLTC};</p> <p>n_{city};</p> <p>n_{low};</p> <p>n_{med};</p> <p>n_{high};</p> <p>n_{exHigh}.</p>
3	Output step 1 Output step 2	$\Delta E_{REESS,j}$, Wh; UBE_{CCP} , Wh. n_{WLTC} ; n_{city} ; n_{low} ; n_{med} ; n_{high} ; n_{exHigh} .	<p>Calculation of weighting factors according to paragraph 4.4.2.2. of this annex.</p> <p>Note: The number of weighting factors depends on the applicable cycle that was used (3- or 4-phase WLTC). In the case of 4-phase WLTCs, the output in brackets might be needed in addition.</p> <p>Output is available for each test.</p> <p>In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.</p>	<p>$K_{WLTC,1}$ $K_{WLTC,2}$ $K_{WLTC,3}$ $(K_{WLTC,4})$ $K_{city,1}$ $K_{city,2}$ $K_{city,3}$ $(K_{city,4})$ $K_{low,1}$ $K_{low,2}$ $K_{low,3}$ $(K_{low,4})$ $K_{med,1}$ $K_{med,2}$ $K_{med,3}$ $(K_{med,4})$ $K_{high,1}$ $K_{high,2}$ $K_{high,3}$ $(K_{high,4})$ $K_{exHigh,1}$ $K_{exHigh,2}$ $K_{exHigh,3}$ $(K_{exHigh,4})$</p>

Step no.	Source	Input	Process	Output
4	Output step 1	$\Delta E_{REESS,j}$, Wh; d_j , km; UBE_{CCP} , Wh.	Calculation of electric energy consumption at the REESSs according to paragraph 4.4.2.2. of this annex.	$EC_{DC,WLTC}$, Wh/km; $EC_{DC,city}$, Wh/km; $EC_{DC,low}$, Wh/km; $EC_{DC,med}$, Wh/km; $EC_{DC,high}$, Wh/km;
	Output step 2	n_{WLTC} ; n_{city} ; n_{low} ; n_{med} ; n_{high} ; n_{exHigh} .	Calculation of the electric energy consumption from the first applicable WLTP test cycle $EC_{DC,first}$ as described in paragraph 1.2. of Appendix 8, paragraph 1.1. to this annex.	$EC_{DC,exHigh}$, Wh/km; $EC_{DC,first}$, Wh/km.
	Output step 3	All weighting factors	Output is available for each test. In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.	
5	Output step 1	UBE_{CCP} , Wh;	Calculation of pure electric range according to paragraph 4.4.2.2. of this annex.	PER_{WLTC} , km; PER_{city} , km; PER_{low} , km; PER_{med} , km; PER_{high} , km; PER_{exHigh} , km.
	Output step 4	$EC_{DC,WLTC}$, Wh/km; $EC_{DC,city}$, Wh/km; $EC_{DC,low}$, Wh/km; $EC_{DC,med}$, Wh/km; $EC_{DC,high}$, Wh/km; $EC_{DC,exHigh}$, Wh/km.	Output is available for each test. In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.	
6	Output step 1	E_{AC} , Wh;	Calculation of electric energy consumption at the mains according to paragraph 4.3.4. of this annex.	EC_{WLTC} , Wh/km; EC_{city} , Wh/km; EC_{low} , Wh/km; EC_{med} , Wh/km; EC_{high} , Wh/km; EC_{exHigh} , Wh/km.
	Output step 5	PER_{WLTC} , km; PER_{city} , km; PER_{low} , km; PER_{med} , km; PER_{high} , km; PER_{exHigh} , km.	Output is available for each test. In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.	

Step no.	Source	Input	Process	Output
7	Output step 5	PER _{WLTC} , km; PER _{city} , km; PER _{low} , km; PER _{med} , km; PER _{high} , km; PER _{exHigh} , km;	<p>Averaging of tests for all input values.</p> <p>Declaration of PER_{WLTC,dec} and EC_{WLTC,dec} based on PER_{WLTC,ave} and EC_{WLTC,ave}.</p> <p>Alignment of PER in case of city, low, med, high and exHigh based on the ratio between PER_{WLTC,dec} and PER_{WLTC,ave}:</p> $AF_{PER} = \frac{PER_{WLTC,dec}}{PER_{WLTC,ave}}$ <p>Alignment of EC in case of city, low, med, high and exHigh based on the ratio between EC_{WLTC,dec} and EC_{WLTC,ave}:</p> $AF_{EC} = \frac{EC_{WLTC,dec}}{EC_{WLTC,ave}}$ <p>In the case that the interpolation method is applied, the output is available for vehicles vehicle H and vehicle L. PER_{WLTC,dec} as well as EC_{WLTC,dec} shall be rounded according to paragraph 6.1.8. of this Regulation to the number of places of decimal as specified in Table A6/1 of Annex B6.</p> <p>In the case that the interpolation method is not applied, PER_{WLTC,dec} and EC_{WLTC,dec} shall be rounded according to paragraph 6.1.8. of this Regulation to the nearest whole number.</p>	<p>PER_{WLTC,dec}, km; PER_{WLTC,ave}, km; PER_{city,ave}, km; PER_{low,ave}, km; PER_{med,ave}, km; PER_{high,ave}, km; PER_{exHigh,ave}, km;</p> <p>EC_{WLTC,dec}, Wh/km; EC_{WLTC,ave}, Wh/km; EC_{city,ave}, Wh/km; EC_{low,ave}, Wh/km; EC_{med,ave}, Wh/km; EC_{high,ave}, Wh/km; EC_{exHigh,ave}, Wh/km; EC_{DC,first,ave}, Wh/km.</p>
8	Output step 7	EC _{WLTC,dec} , Wh/km; EC _{WLTC,ave} , Wh/km; EC _{DC,first,ave} , Wh/km.	<p>Adjustment of the electric energy consumption for the purpose of COP as described in paragraph 1.2. of Appendix 8, paragraph 1.1. to this annex.</p> <p>In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.</p>	EC _{DC,COP} , Wh/km.

"

Annex B8, paragraph 4.7.2., Table A8/11, rows Step no. 1, Step no. 2, Step no. 3, Step no. 4, Step no. 5, Step no. 7, Step no. 8 and Step no. 9, amend to read:

“

Step no.	Source	Input	Process	Output
1	Annex B8	Test results	<p>Results measured according to Appendix 3 to this annex, and pre-calculated according to paragraph 4.3. of this annex.</p> <p>Usable battery energy according to paragraph 4.4.2.1.1. of this annex.</p> <p>Recharged electric energy according to paragraph 3.4.4.3. of this annex.</p> <p>Output is available for each test.</p> <p>E_{AC} shall be rounded according to paragraph 6.1.8. of this Regulation to the first place of decimal.</p> <p>In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.</p>	<p>$\Delta E_{REESS,j}$, Wh; d_j, km;</p> <p>UBE_{STP}, Wh;</p> <p>E_{AC}, Wh.</p>
2	Output step 1	$\Delta E_{REESS,j}$, Wh; UBE_{STP} , Wh.	<p>Calculation of weighting factors according to paragraph 4.4.2.1. of this annex.</p> <p>Output is available for each test.</p> <p>In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.</p>	<p>$K_{WLTC,1}$ $K_{WLTC,2}$ $K_{city,1}$ $K_{city,2}$ $K_{city,3}$ $K_{city,4}$ $K_{low,1}$ $K_{low,2}$ $K_{low,3}$ $K_{low,4}$ $K_{med,1}$ $K_{med,2}$ $K_{med,3}$ $K_{med,4}$ $K_{high,1}$ $K_{high,2}$ $K_{exHigh,1}$ $K_{exHigh,2}$</p>

Step no.	Source	Input	Process	Output
3	Output step 1 Output step 2	$\Delta E_{REESS,j}$, Wh; d_j , km; UBE_{STP} , Wh. All weighting	Calculation of electric energy consumption at the REESSs according to paragraph 4.4.2.1. of this annex. Calculation of the electric energy consumption from the first applicable WLTP test cycle $EC_{DC,first}$ as described in paragraph 1.2. of Appendix 8; paragraph 1.1. to this annex. Output is available for each test. In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.	$EC_{DC,WLTC}$, Wh/km; $EC_{DC,city}$, Wh/km; $EC_{DC,low}$, Wh/km; $EC_{DC,med}$, Wh/km; $EC_{DC,high}$, Wh/km; $EC_{DC,exHigh}$, Wh/km; $EC_{DC,first}$, Wh/km.
4	Output step 1 Output step 3	UBE_{STP} , Wh; $EC_{DC,WLTC}$, Wh/km; $EC_{DC,city}$, Wh/km; $EC_{DC,low}$, Wh/km; $EC_{DC,med}$, Wh/km; $EC_{DC,high}$, Wh/km; $EC_{DC,exHigh}$, Wh/km.	Calculation of pure electric range according to paragraph 4.4.2.1. of this annex. Output is available for each test. In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.	PER_{WLTC} , km; PER_{city} , km; PER_{low} , km; PER_{med} , km; PER_{high} , km; PER_{exHigh} , km.
5	Output step 1 Output step 4	E_{AC} , Wh; PER_{WLTC} , km; PER_{city} , km; PER_{low} , km; PER_{med} , km; PER_{high} , km; PER_{exHigh} , km.	Calculation of electric energy consumption at the mains according to paragraph 4.3.4. of this annex. Output is available for each test. In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.	EC_{WLTC} , Wh/km; EC_{city} , Wh/km; EC_{low} , Wh/km; EC_{med} , Wh/km; EC_{high} , Wh/km; EC_{exHigh} , Wh/km.
7	Output step 6	$EC_{WLTC,dec}$, Wh/km; $EC_{WLTC,ave}$, Wh/km; $EC_{DC,first,ave}$, Wh/km.	Adjustment of the electric energy consumption for the purpose of COP as described in Paragraph 1.2. of Appendix 8; Paragraph 1.1. to this annex. In the case that the interpolation method is applied, the output is available for vehicle H and vehicle L.	$EC_{DC,COP}$, Wh/km.

<i>Step no.</i>	<i>Source</i>	<i>Input</i>	<i>Process</i>	<i>Output</i>
Result of an individual vehicle. Final test result.	Output step 8	<p>PER_{city,final}, km; PER_{low,final}, km; PER_{med,final}, km; PER_{high,final}, km; PER_{exHigh,final}, km;</p> <p>EC_{city,final}, Wh/km; EC_{low,final}, Wh/km; EC_{med,final}, Wh/km; EC_{high,final}, Wh/km; EC_{exHigh,final}, Wh/km;</p> <p>EC_{DC,COP,final}, Wh/km.</p>	<p>final rounding according to paragraph 6.1.8. of this Regulation.</p> <p>PER_{ind}, PER_{city,ind}, and PER_{p,ind} shall be rounded to the nearest whole number.</p> <p>EC_{ind}, EC_{city} and EC_{p,ind} shall be rounded to the nearest whole number.</p> <p>EC_{DC,COP,ind} shall be rounded to the nearest whole number.</p> <p>Output is available for each individual vehicle.</p>	<p>PER_{high,ind}, km; PER_{exHigh,ind}, km;</p> <p>EC_{WLTC,ind}, Wh/km; EC_{city,ind}, Wh/km; EC_{low,ind}, Wh/km; EC_{med,ind}, Wh/km; EC_{high,ind}, Wh/km; EC_{exHigh,ind}, Wh/km;</p> <p>EC_{DC,COP,ind}, Wh/km.</p>

"

Annex B8, Appendix 2, amend the introduction text to read (previous bold text remains bold):

"Annex B8 - Appendix 2

REESS energy change-based correction procedure

This Appendix describes the procedure to correct the charge-sustaining Type 1 test CO₂ mass emission for NOVC-HEVs and OVC-HEVs, and the fuel consumption for NOVC-FCHVs and OVC-FCHVs (if applicable) as a function of the electric energy change of all REESSs."

Annex B8, Appendix 2, paragraph 1.1.1., amend to read:

"1.1.1. The correction shall be applied on the phase-specific fuel consumptions for NOVC-FCHVs and OVC-FCHVs of the charge-sustaining Type 1 test, and on the phase-specific CO₂ mass emissions for NOVC-HEVs and OVC-HEVs of the charge-sustaining Type 1 test."

Annex B8, Appendix 2, paragraph 1.1.2., amend to read:

"1.1.2. The application of the correction over the total cycle on the fuel consumption for NOVC-FCHVs and OVC-FCHVs, on the CO₂ mass emission for NOVC-HEVs and OVC-HEVs is based on the charge-sustaining REESS energy change $\Delta E_{\text{REESS,CS}}$ of the charge-sustaining Type 1 test and the correction criterion c.

For the calculation of $\Delta E_{\text{REESS,CS}}$, paragraph 4.3. of this annex shall be used. The considered period j used in paragraph 4.3. of this annex is defined by the charge-sustaining Type 1 test. The correction criterion c shall be determined according to paragraph 1.2. of this Appendix."

Annex B8, Appendix 2, paragraph 1.1.3., amend to read:

"1.1.3. The correction over the total cycle shall be applied on the fuel consumption for NOVC-FCHVs and OVC-FCHVs, the CO₂ mass emission for NOVC-HEVs and OVC-HEVs if $\Delta E_{\text{REESS,CS}}$ is negative which corresponds to REESS discharging and the correction criterion c calculated in paragraph 1.2. of this appendix is greater than the applicable threshold according to Table A8.App2/1.

In Annex B8, Appendix 2, paragraph 1.1.4., amend to read:

"1.1.4. The correction over the total cycle may be omitted on the fuel consumption for NOVC-FCHVs and OVC-FCHVs, the CO₂ mass emission for NOVC-HEVs and OVC-HEVs and uncorrected values may be used if:

- (a) $\Delta E_{\text{REESS,CS}}$ is positive which corresponds to REESS charging and the correction criterion c calculated in paragraph 1.2. of this appendix is greater than the applicable threshold according to Table A8.App2/1;
- (b) The correction criterion c calculated in paragraph 1.2. of this appendix is smaller than the applicable threshold according to Table A8.App2/1;
- (c) The manufacturer can prove to the responsible authority by measurement that there is no relation between $\Delta E_{\text{REESS,CS}}$ and charge-sustaining CO₂ mass emission and $\Delta E_{\text{REESS,CS}}$ and fuel consumption respectively."

Annex B8, Appendix 2, paragraph 2.1., amend to read:

"2.1. The CO₂ mass emission correction coefficient K_{CO_2} , the fuel consumption correction coefficients $K_{\text{fuel,FCHV}}$, as well as, if required by the manufacturer, the phase-specific correction coefficients $K_{\text{CO}_2,p}$ and $K_{\text{fuel,FCHV,p}}$ shall be developed based on the applicable charge-sustaining Type 1 test cycles.

In the case that vehicle H was tested for the development of the correction coefficient for CO₂ mass emission for NOVC-HEVs and OVC-HEVs, the coefficient may be applied to vehicles that fulfil the same interpolation family criteria. **For interpolation families which fulfil the criteria of the KCO₂ correction factor family, defined in paragraph 6.3.11. of this Regulation, the same KCO₂ value may be applied."**

Annex B8, Appendix 2, paragraph 2.2., amend to read:

"2.2. The correction coefficients shall be determined from a set of charge-sustaining Type 1 tests according to paragraph 3. of this appendix. The number of tests performed by the manufacturer shall be equal to or greater than five.

~~The manufacturer may request to set the state of charge of the REESS prior to the test according to the manufacturer's recommendation and as described in paragraph 3. of this appendix. This practice shall only be used for the purpose of achieving a charge-sustaining Type 1 test with opposite sign of the $\Delta E_{\text{REESS,CS}}$ and with approval of the responsible authority.~~

The state of charge of the REESS may be set prior to the test according to the manufacturer's recommendation in agreement with the responsible authority and as described in paragraph 3. This practice shall only be used for the purpose of achieving a charge-sustaining Type 1 test with opposite sign of the $\Delta E_{\text{REESS,CS}}$.

The set of measurements shall fulfil the following criteria:

- (a) The set shall contain at least one test with $\Delta E_{\text{REESS,CS},n} \leq 0$ and at least one test with $\Delta E_{\text{REESS,CS},n} > 0$. $\Delta E_{\text{REESS,CS},n}$ is the sum of electric energy changes of all REESSs of test n calculated according to paragraph 4.3. of this annex.
- (b) The difference in $M_{\text{CO}_2,\text{CS}}$ between the test with the highest negative electric energy change and the test with the highest positive electric energy change shall be greater than or equal to 5 g/km. This criterion shall not be applied for the determination of $K_{\text{fuel,FCHV}}$.

In the case of the determination of K_{CO_2} , the required number of tests may be reduced to three tests if all of the following criteria are fulfilled in addition to (a) and (b):

- (c) The difference in $M_{\text{CO}_2,\text{CS}}$ between any two adjacent measurements, related to the electric energy change during the test, shall be less than or equal to 10 g/km.
- (d) In addition to (b), the test with the highest negative electric energy change and the test with the highest positive electric energy change shall not be within the region that is defined by:

$$-0.01 \leq \frac{\Delta E_{\text{REESS}}}{E_{\text{fuel}}} \leq +0.01,$$

where:

E_{fuel} is the energy content of the consumed fuel calculated according to paragraph 1.2. of this appendix, Wh.

- (e) The difference in $M_{\text{CO}_2,\text{CS}}$ between the test with the highest negative electric energy change and the mid-point, and the difference in $M_{\text{CO}_2,\text{CS}}$ between the mid-point and the test with the highest positive electric energy change shall be similar and preferably be within the range defined by (d). If this requirement is not feasible, the responsible authority shall decide if a retest is necessary.

The correction coefficients determined by the manufacturer shall be reviewed and approved by the responsible authority prior to ~~its~~ **their** application.

If the set of at least five tests does not fulfil criterion (a) or criterion (b) or both, the manufacturer shall provide evidence to the responsible authority as to why the vehicle is not capable of meeting either or both criteria. If the responsible authority is not satisfied with the evidence, it may require additional tests to be performed. If the criteria after additional tests are still not fulfilled, the responsible authority shall determine a conservative correction coefficient, based on the measurements."

Annex B8, Appendix 2, paragraph 2.3.2., amend to read:

"2.3.2. Determination of CO₂ ~~mass~~-emission correction coefficient K_{CO_2}

For OVC-HEVs and NOVC-HEVs, the CO₂ ~~mass~~-emission correction coefficient K_{CO_2} , determined by driving a set of charge-sustaining Type 1 tests, is defined by the following equation:

$$K_{CO_2} = \frac{\sum_{n=1}^{n_{CS}} \left((EC_{DC,CS,n} - EC_{DC,CS,avg}) \times (M_{CO_2,CS,nb,n} - M_{CO_2,CS,nb,avg}) \right)}{\sum_{n=1}^{n_{CS}} (EC_{DC,CS,n} - EC_{DC,CS,avg})^2}$$

where:

K_{CO_2} is the CO₂ ~~mass~~-emission correction coefficient, (g/km)/(Wh/km);

$EC_{DC,CS,n}$ is the charge-sustaining electric energy consumption of test n based on the REESS depletion according to paragraph 2.3.1. of this appendix, Wh/km;

$EC_{DC,CS,avg}$ is the arithmetic average of the charge-sustaining electric energy consumption of n_{CS} tests based on the REESS depletion according to paragraph 2.3.1. of this appendix, Wh/km;

$M_{CO_2,CS,nb,n}$ is the charge-sustaining CO₂ ~~mass~~-emission of test n, not corrected for the energy balance, calculated according Table A8/5, step No. 2, g/km;

$M_{CO_2,CS,nb,avg}$ is the arithmetic average of the charge-sustaining CO₂ ~~mass~~-emission of n_{CS} tests based on the CO₂ ~~mass~~ emission, not corrected for the energy balance, according to the equation below, g/km;

n is the index number of the considered test;

n_{CS} is the total number of tests;

and:

$$M_{CO_2,CS,nb,avg} = \frac{1}{n_{CS}} \times \sum_{n=1}^{n_{CS}} M_{CO_2,CS,nb,n}$$

The CO₂ ~~mass~~-emission correction coefficient shall be rounded according to paragraph 6.1.8. of this Regulation to four significant figures. The statistical significance of the CO₂ ~~mass~~-emission correction coefficient shall be evaluated by the responsible authority."

Annex B8, Appendix 2, paragraph 2.3.2.1., amend to read:

"2.3.2.1. It is permitted to apply the CO₂ ~~mass~~ emission correction coefficient developed from tests over the whole applicable WLTP test cycle for the correction of each individual phase."

Annex B8, Appendix 2, paragraph 2.3.2.2., amend to read:

"2.3.2.2. Additional to the requirements of paragraph 2.2. of this appendix, at the request of the manufacturer and upon approval of the responsible authority, separate CO₂ ~~mass~~ emission correction coefficients $K_{CO_2,p}$ for each individual phase

may be developed. In this case, the same criteria as described in paragraph 2.2. of this appendix shall be fulfilled in each individual phase and the procedure described in paragraph 2.3.2. of this appendix shall be applied for each individual phase to determine phase-specific correction coefficients."

Annex B8, Appendix 2, paragraph 3.1.1.3.4., amend to read:

"3.1.1.3.4. To obtain a set of applicable WLTP test cycles required for the determination of the correction coefficients **according to paragraph 2.2. of this appendix**, the test may be followed by a number of consecutive sequences **in accordance with the requirements of**~~required according to paragraph 2.2. of this appendix consisting of~~ paragraph 3.1.1.1. to paragraph 3.1.1.3.3. inclusive of this appendix."

Annex B8, Appendix 2, paragraph 3.2.2.3.4., amend to read:

"3.2.2.3.4. To ~~get~~ **obtain** a set of applicable WLTP test cycles that are required for the determination of the correction coefficients, the test can be followed by a number of consecutive sequences required according to paragraph 2.2. of this appendix consisting of paragraphs 3.2.2.2. and 3.2.2.3. of this appendix."

Annex B8, Appendix 2, paragraph 4.1., amend to read:

"4.1. In this case, the corrected charge-sustaining CO₂ ~~mass~~ emission defined in paragraphs 4.1.1.3., 4.1.1.4. and 4.1.1.5. of this annex shall be replaced by $\Delta M_{CO_2,j}$ instead of $K_{CO_2,j} \times EC_{DC,CS,j}$."

Annex B8, Appendix 3, amend Table A8 App3/1 to read:

"

Test events	Paragraph- 3.1.	Paragraph- 3.2.		Paragraph- 3.3.
		60V or more	Less than 60V	
NOVC-HEV	shall not to be used	shall be used		shall not to be used
OVC-HEV CS condition				
NOVC-FCHV				
OVC-FCHV CS condition				
REESS energy change-based correction procedure (Appendix 2)				
Break-Off Criterion calculation for CD-test (Annex B8, paragraph 3.2.5.4.2.)				
OVC-HEV CD condition	shall be used	shall not to be used	allowed to use	allowed to use
OVC-FCHV CD condition				
PEV				

"

Annex B8, Appendix 6, paragraph 1.2., amend to read:

"1.2. The manufacturer shall provide evidence to the responsible authority concerning:

- (a) The availability of a predominant mode under the considered conditions;

- (b) The maximum speed of the considered vehicle;
and if required:
- (c) The best and worst case mode identified by the evidence on the fuel consumption and, if applicable, on the CO₂ ~~mass~~ emission/fuel consumption in all modes. See paragraph 2.6.6.3. of Annex B6;
- (d) The highest electric energy consuming mode;
- (e) The cycle energy demand (according to paragraph 5 of Annex B7 where the target speed is replaced by the actual speed) ."

Annex B8, Appendix 8, replace the entire text to read (not presented in bold to show the intended bold and non-bold text and deleted text not shown):

"Annex B8 - Appendix 8

Determination of additional electric energy consumption values required for checking the Conformity of Production of PEVs and OVC-HEVs

1. PEVs
 - 1.1. The following value shall be determined and used as a reference value for verifying the conformity of production:

In the case that the interpolation method is applied,

$$EC_{DC-ind,COP} = EC_{DC-L,COP} + K_{ind} \times (EC_{DC-H,COP} - EC_{DC-L,COP})$$

In the case that the interpolation method is not applied,

$$EC_{DC-ind,COP} = EC_{DC-i,COP}$$

where:

$EC_{DC-ind,COP}$ is the reference electric energy consumption of an individual vehicle for the conformity of production, Wh/km;

$EC_{DC-L,COP}$ is the electric energy consumption of vehicle L determined according to paragraph 1.2. of this appendix, Wh/km;

$EC_{DC-H,COP}$ is the electric energy consumption of vehicle H determined according to paragraph 1.2. of this appendix, Wh/km;

$EC_{DC-i,COP}$ is the electric energy consumption of vehicle i determined according to paragraph 1.2. of this appendix, Wh/km;

K_{ind} is the interpolation coefficient for the considered individual vehicle for the applicable WLTP test cycle, according to paragraph 4.5.3. of this annex.

- 1.2. Calculation of the $EC_{DC-L,COP}$, $EC_{DC-H,COP}$ and $EC_{DC-i,COP}$

$$EC_{DC-i,COP} = EC_{DC,first,i} \times AF_{EC,i}$$

where:

i represents – in the case the interpolation method is applied – the index L for vehicle L and the index H for vehicle H. In the case the interpolation method is not applied, index i represents the vehicle tested.

$EC_{DC-i,COP}$ is the aligned electric energy consumption of vehicle i based on the REESS depletion of the first applicable WLTP test cycle, Wh/km;

$EC_{DC,first,i}$ is average of the measured electric energy consumption of vehicle i based on the REESS depletion of the first applicable WLTP test cycle according to paragraph 4.3. of this annex, Wh/km;

$AF_{EC,i}$ is the alignment factor of vehicle i according to Table A8/10 Step no.7 for the consecutive cycle Type 1 procedure

or Table A8/11 Step no.6 for the shortened Type 1 test procedure

2. OVC-HEVs

This paragraph shall only be applied if there is no engine start in the first cycle of the charge-depleting Type 1 test during Type Approval. In the case there is an engine start, this paragraph shall be omitted.

2.1. The following value shall be determined and used as a reference value for verifying the conformity of production:

In the case that the interpolation method is applied,

$$EC_{DC-ind,CD,COP} = EC_{DC-L,CD,COP} + K_{ind} \times (EC_{DC-H,CD,COP} - EC_{DC-L,CD,COP})$$

In the case that the interpolation method is not applied,

$$EC_{DC-ind,CD,COP} = EC_{DC-i,CD,COP}$$

where:

$EC_{DC-ind,CD,COP}$ is the reference charge-depleting electric energy consumption of an individual vehicle for the conformity of production, Wh/km;

$EC_{DC-L,CD,COP}$ is the charge-depleting electric energy consumption of vehicle L determined according to paragraph 2.2. of this appendix, Wh/km;

$EC_{DC-H,CD,COP}$ is the charge-depleting electric energy consumption of vehicle H determined according to paragraph 2.2. of this appendix, Wh/km;

$EC_{DC-i,CD,COP}$ is the charge-depleting electric energy consumption of vehicle i determined according to paragraph 2.2. of this appendix, Wh/km;

K_{ind} is the interpolation coefficient for the considered individual vehicle for the applicable WLTP test cycle, according to paragraph 4.5.3. of this annex.

2.2. Calculation of the $EC_{DC-L,CD,COP}$, $EC_{DC-H,CD,COP}$ and $EC_{DC-i,CD,COP}$

$$EC_{DC-i,CD,COP} = EC_{DC-i,CD,first} \times AF_{EC,AC,CD,i}$$

where:

i represents – in the case the interpolation method is applied – the index L for vehicle L and the index H for vehicle H. In the case the interpolation method is not applied, index i represents the vehicle tested.

$EC_{DC-i,CD,COP}$ is the aligned charge-depleting electric energy consumption based on the REESS depletion of the first applicable WLTC test cycle, Wh/km;

$EC_{DC-i,CD,first}$ is average of the measured charge-depleting electric energy consumption of vehicle i based on the REESS depletion of the first applicable WLTC test cycle according to paragraph 4.3. of this annex, Wh/km;

$AF_{EC,AC,CD,i}$ is the alignment factor of vehicle i

where

For 4-phase WLTP

$$AF_{EC,AC,CD,i} = \frac{EC_{AC,CD,declared,i}}{EC_{AC,CD,ave,i}}$$

where

$EC_{AC,CD,declared,i}$ is the declared charge-depleting electric energy consumption of vehicle *i* according to Table A8/8 Step no. 14, Wh/km;

$EC_{AC,CD,ave,i}$ is the average of the measured charge-depleting electric energy consumption of vehicle *i* according to Table A8/8 Step no. 13, Wh/km;

For 3-phase WLTP

$$AF_{EC,AC,CD,i} = \frac{EC_{dec,i}}{EC_{ave,i}}$$

where

$EC_{dec,i}$ is the declared electric energy consumption of vehicle *i* of the charge-depleting Type 1 test according to Table A8/9 Step no. 8, Wh/km;

$EC_{ave,i}$ is the average of the measured electric energy consumption of vehicle *i* of the charge-depleting Type 1 test according to Table A8/9 Step no. 8."

Annex C3, paragraph 4.2.3.4., amend to read:

"4.2.3.4. Calculations

The calculation of net hydrocarbon mass change within the enclosure is used to determine the chamber's hydrocarbon background and leak rate. Initial and final readings of hydrocarbon concentration, temperature and barometric pressure are used ~~in the following formula~~ to calculate the mass change.

The calculation shall be undertaken in accordance **with the equation in either paragraph 7.1. or alternatively paragraph 7.1.1.** ~~paragraph 7.~~ of this annex, using the following value for *V*.

V is the net enclosure volume, m³."

Annex C3, paragraph 6.5.9.1., amend the title of the table and the reference to it to read (previous bold text remains bold):

"6.5.9.1. The test vehicle shall be exposed to two cycles of ambient temperature in accordance with the profile specified in Table ~~€4/4C3/1~~ with a maximum deviation of ±2 °C at any time. The average temperature deviation from the profile, calculated using the absolute value of each measured deviation, shall not exceed ±1 °C. Ambient temperature shall be measured and recorded at least every minute. Temperature cycling shall begin at time $T_{start} = 0$, as specified in paragraph 6.5.9.6. of this annex.

Table ~~€4/4C3/1~~
Diurnal"

Annex C3, paragraph 6.6.1.6., amend to read:

"6.6.1.6. Preparation of carbon canister depressurisation puff loss loading

After completing carbon canister loading and purging, the test vehicle shall be moved into an enclosure, either a SHED or an appropriate climatic chamber. It shall be demonstrated that the system is leak-free and the pressurisation is performed in a normal way during the test or by a separate test (e.g. by means

of pressure sensor on the vehicle). The test vehicle shall be subsequently exposed to the first 11 hours of the ambient temperature profile specified for the diurnal emission test in Table ~~C4/2C3/1~~ with a maximum deviation of ± 2 °C at any time. The average temperature deviation from the profile, calculated using the absolute value of each measured deviation, shall not exceed ± 1 °C. The ambient temperature shall be measured and recorded at least every 10 minutes."

Annex C3, paragraph 6.6.1.9., amend to read:

"6.6.1.9. Soak

After completing puff loss loading the vehicle carbon canister shall be replaced with a dummy carbon canister (of the same specification as the original but not necessarily aged), the vehicle shall then be soaked at ~~23 \pm 2 °C~~ **23 \pm 3 °C** for 6 to 36 hours to stabilise the vehicle temperature."

Annex C3, paragraph 6.6.2., amend the title of the table and the reference to it to read (previous bold text remains bold):

"6.6.2. In the case that the fuel tank relief pressure is lower than 30 kPa

The test shall be performed as described in paragraphs 6.6.1.1. to 6.6.1.13. inclusive of this annex. However, in this case, the ambient temperature described in paragraph 6.5.9.1. of this annex shall be replaced by the profile specified in Table ~~C4/2C3/2~~ of this annex for the diurnal emission test.

Table ~~C4/2C3/2~~

Ambient"

Annex C3, paragraph 7.1., amend to read:

"7.1.

K is $1.2 \times 10^{-4} \times (12 + H/C)$, in $(g \times K / (m^3 \times kPa))$;

i is the initial reading;

f is the final reading; "

Annex C3, paragraph 8., amend to read:

"8. Test report

The test report shall contain at least the following:

- (a) Description of the soak periods, including time and mean temperatures;
- (b) Description of aged carbon canister used and reference to exact ageing report;
- (c) Mean temperature during the hot soak test;
- (d) Measurement during hot soak test, HSL;
- (e) Measurement of first diurnal, ~~DL1st day~~ **DL1st day**;
- (f) Measurement of second diurnal, ~~DL2nd day~~ **DL2nd day**;
- (g) Final evaporative test result, calculated according to paragraph 7. of this annex;
- (h) Declared fuel tank relief pressure of the system (for sealed tank systems);
- (i) Puff loss loading value (in the case of using 'stand-alone test procedure' described in paragraph 6.7. of this annex). "

Annex C4, paragraph 1.2., amend to read:

"1.2. The whole vehicle durability test shall preferably be performed on a vehicle with the cycle energy demand of the VH (as defined in paragraph 4.2.1.1.2. of Annex B4) with the highest cycle energy demand of all of the Interpolation Families to be included in the durability family and shall be driven on a test track, on the road, or on a chassis dynamometer. The cycle energy **demand** of the test vehicle may be further increased to cover future extensions."

Annex C5, paragraph 3.2.1.2., amend to read:

"3.2.1.2. A manufacturer may disable **any specific OBD monitor for a given driving cycle for ambient or engine** ~~the OBD system at ambient engine starting~~ temperatures below 266 K (-7 °C) or at elevations over 2,440 metres above sea level provided the manufacturer submits data and/or an engineering evaluation which adequately demonstrate that monitoring would be unreliable when such conditions exist. A manufacturer may also request disablement of **any specific OBD monitor** ~~the OBD system~~ at other **ambient temperatures or other elevations** ~~ambient engine starting temperatures~~ if ~~he~~ **they** demonstrates to the authority with data and/or an engineering evaluation that misdiagnosis would occur under such conditions. It is not necessary to illuminate the Malfunction Indicator (MI) if ~~the~~ OBD thresholds are exceeded during a regeneration provided no defect is present."

Annex C5, paragraph 3.3.3.4., amend to read:

"3.3.3.4. Other emission control system components or systems, or emission related ~~power train~~ **powertrain** components or systems which are connected to a computer, if active on the selected fuel, the failure of which may result in tailpipe emissions exceeding any of the OBD thresholds set out in Table 4A and Table 4B (as applicable) in paragraph 6.8.2. of this Regulation.

The following is a non-exhaustive list providing examples of representative components and systems;

- (a) Exhaust gas recirculation system
- (b) Fuel system
- (c) Secondary air system
- (d) Valve timing system
- (e) Atmosphere pressure sensor
- (f) Intake air pressure sensor
- (g) Intake air temperature sensor
- (h) Air flow sensor
- (i) Engine coolant temperature sensor
- (j) Throttle sensor
- (k) Cylinder identification sensor
- (l) Crank angle sensor"

Annex C5, paragraph 3.3.3.5., amend to read:

"3.3.3.5. Unless otherwise monitored, any other emission-related ~~power train~~ **powertrain** component connected to a computer, including any relevant sensors to enable monitoring functions to be carried out, shall be monitored for circuit ."

Annex C5, paragraph 3.3.4., renumber paragraphs 3.3.4.1. to 3.3.4.8. to sub paragraphs (a) to (h) and renumber sub paragraphs (a) to (p) to sub paragraphs (i) to (xvi) to read:

- "3.3.4. Monitoring requirements for vehicles equipped with compression-ignition engines
- In satisfying the requirements of paragraph 3.3.2. of this annex the OBD system shall monitor:
- ~~3.3.4.1.~~ (a) Where fitted, reduction in the efficiency of the catalytic converter.
- ~~3.3.4.2.~~ (b) Where fitted, the functionality and integrity of the particulate trap.
- ~~3.3.4.3.~~ (c) The fuel-injection system electronic fuel quantity and timing actuator(s) is/are monitored for circuit continuity and total functional failure.
- ~~3.3.4.4.~~ (d) Other emission control system components or systems, or emission-related power-train components or systems, which are connected to a computer, the failure of which may result in exhaust emissions exceeding any of the OBD thresholds set out in paragraph 6.8.2. of this Regulation. Examples of such systems or components are those for monitoring and control of air mass-flow, air volumetric flow (and temperature), boost pressure and inlet manifold pressure (and relevant sensors to enable these functions to be carried out).
- ~~3.3.4.5.~~ (e) Unless otherwise monitored, any other emission-related power-train component connected to a computer shall be monitored for circuit continuity.
- ~~3.3.4.6.~~ (f) Malfunctions and the reduction in efficiency of the EGR system shall be monitored.
- ~~3.3.4.7.~~ (g) Malfunctions and the reduction in efficiency of a NO_x after-treatment system using a reagent and the reagent dosing sub-system shall be monitored.
- ~~3.3.4.8.~~ (h) Malfunctions and the reduction in efficiency of NO_x after-treatment not using a reagent shall be monitored."

Annex C5, paragraph 3.6.1., amend to read:

- "3.6.1. The OBD system shall record pending and confirmed fault code(s) indicating the status of the emission control system. Separate status codes (readiness codes) shall be used to identify correctly functioning emission control systems and those emission control systems which need further vehicle operation to be fully evaluated. If the MI is activated due to deterioration or malfunction or permanent emission default modes of operation, a fault code shall be stored that identifies the type of malfunction. A fault code shall also be stored in the cases referred to in paragraphs 3.3.3.5. and ~~3.3.4.5.~~ **3.3.4. (e)** of this annex."

Annex C5, paragraph 4.3., amend to read:

- "4.3. In determining the identified order of deficiencies, deficiencies relating to paragraphs 3.3.3.1., 3.3.3.2. and 3.3.3.3. of this annex for positive ignition engines and paragraphs ~~3.3.4.1.~~ **3.3.4. (a)**, ~~3.3.4.2.~~ **(b)** and ~~3.3.4.3.~~ **(c)** of this annex for compression-ignition engines shall be identified first."

Annex C5, Appendix 1, add new paragraph 2.4. to read:

- "**2.4. For OVC-HEVs, testing shall be carried out under charge-sustaining conditions.**"

Annex C5, Appendix 1, paragraph 6.3.1.4., amend to read:

- "6.3.1.4. Electrical disconnection of any other emission-related component connected to a ~~power-train~~ **powertrain** management computer (if active on the selected fuel type);"

Annex C5, paragraph 6.3.2.4., amend to read:

- "6.3.2.4. Electrical disconnection of any other emission-related component connected to a ~~power-train~~ **powertrain** management computer."

Annex C5, paragraph 6.4.1.6., amend to read:

"6.4.1.6. Electrical disconnection of any other emission-related ~~power-train~~ **powertrain** component connected to a computer that results in emissions exceeding any of the OBD thresholds set out in paragraph 6.8.2. of this Regulation (if active on the selected fuel type)."

Annex C5, paragraph 6.4.2.1., amend to read:

"6.4.2.1. After vehicle preconditioning according to paragraph 6.2. of this appendix, the test vehicle is driven over a Type 1 test.

The MI shall be activated at the latest before the end of this test under any of the conditions given in paragraphs 6.4.2.2. to 6.4.2.5 of this appendix. The MI may also be activated during preconditioning. The technical service may substitute those failure modes by others in accordance with paragraph ~~3.3.4.4.~~ **3.3.4. (d)** of this annex. However, the total number of failures simulated shall not exceed four (4) for the purposes of type approval."

Annex C5, paragraph 6.4.2.5., amend to read:

"6.4.2.5. With reference to paragraph 6.3.2.5. of this appendix, disconnection of any other emission-related ~~power-train~~ **powertrain** component connected to a computer that results in emissions exceeding any of the OBD thresholds set out in paragraph 6.8.2. of this Regulation."

Annex C5, paragraph 6.5.1.2., amend to read:

"6.5.1.2. If available, the following signals in addition to the required freeze-frame information shall be made available on demand through the serial port on the standardised data link connector, if the information is available to the on-board computer or can be determined using information available to the on-board computer: ~~number~~ **quantity** of diagnostic trouble codes, engine coolant temperature, fuel system status (e.g. closed-loop, open-loop), fuel trim value(s), ignition timing advance, intake air temperature, intake manifold air pressure, air flow rate, engine speed (RPM), throttle position sensor output value, secondary air status (upstream, downstream or atmosphere), calculated load value, vehicle speed, fuel pressure, oxygen sensor, **and** lambda sensor, ~~and number of fault code.~~

The signals shall be provided in standard units based on the specifications given in paragraph 6.5.3. of this appendix. Actual signals shall be clearly identified separately from default value or limp-home signals."

Annex C5, paragraph 6.5.3.2., amend to read:

"6.5.3.2. Standards used for the transmission of OBD relevant information:

- (a) ISO 15031-5 "Road vehicles - communication between vehicles and external test equipment for emissions-related diagnostics – Part 5: Emissions-related diagnostic services", dated 1 April 2011 or SAE J1979 dated 23 February 2012;
- (b) ISO 15031-4 "Road vehicles – Communication between vehicle and external test equipment for emissions related diagnostics – Part 4: External test equipment", dated 1 June 2005 or SAE J1978 dated 30 April 2002;
- (c) ISO 15031-3 "Road vehicles – Communication between vehicle and external test equipment for emissions related diagnostics Part 3: Diagnostic connector and related electrical circuits: specification and use", dated 1 July 2004 or SAE J 1962 dated 26 July 2012;
- (d) ISO 15031-6 "Road vehicles – Communication between vehicle and external test equipment for emissions related diagnostics – Part 6: Diagnostic trouble code definitions", dated 13 August 2010 or SAE J2012 dated 07 March 2013;

- (e) ISO 27145 "Road vehicles – Implementation of World-Wide Harmonized On-Board Diagnostics (WWH-OBD)" dated 2012-08-15 with the restriction, that only 6.5.3.1.(a) may be used as a data link;
- (f) **SAE J 1979-2 "E/E Diagnostic Test Modes: OBD on UDS", April 2021**. ~~ISO 14229:2013 "Road vehicles – Unified diagnostic services (UDS) with the restriction, that only 6.5.3.1.(a) may be used as a data link".~~

The standards (e) ~~and~~ or (f) may be used as an option instead of (a)."

Annex C5, paragraph 6.5.3.4., amend to read:

"6.5.3.4. Basic diagnostic data, (as specified in paragraph 6.5.1.) and bi-directional control information shall be provided using the format and units described in the standard listed in paragraph 6.5.3.2.(a) of this appendix and must be available using a diagnostic tool meeting the requirements of the standard listed in paragraph 6.5.3.2.(b) of this appendix.

The vehicle manufacturer shall provide to a national standardisation body the details of any emission-related diagnostic data, e.g. PID²s, OBD monitor Id²s, Test ID²s not specified in the standard listed in paragraph 6.5.3.2.(a) of this appendix but related to this Regulation."

Annex C5, paragraph 7.3.2., amend sub paragraph (g) to read:

"(g) Manufacturers may request to use special denominator conditions for certain components or systems and this request can be approved only if it can be demonstrated to the Type Approval Authority by submitting data and/or an engineering evaluation that **those** other conditions are necessary to allow for reliable detection of malfunctions."

II. Justification

1. The majority of proposed amendments are those changes agreed for Series of Amendments 02 which do not warrant a new series, e.g. corrections, clarifications and general improvements.
2. Due to the number of the above mentioned changes and their adoption by GRPE, only additional points are individually justified here.