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AMENDMENTS TO UNECE REGULATIONS

REGULATION No. 83

(Emissions of M₁ and N₁ categories of vehicles)

Proposal for draft amendments to Regulation No. 83

Submitted by the expert from the United Kingdom^{*/}

The text reproduced below was prepared by the expert from the United Kingdom in respect of measurement procedures for Externally Chargeable Hybrid Electric Vehicles. These modifications are backed up by a parallel proposal to amend Regulation No. 101 to better reflect the CO₂ emissions benefits of certain Externally Chargeable Hybrid Electric Vehicles. The aim of this proposal is therefore to maintain alignment between Regulations Nos. 83 and 101. The modifications to the current text of Annex 14 to the Regulation are marked in **bold** characters.

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

A. PROPOSAL

Annex 14, paragraphs 3. to 3.2.4.1., amend to read:

"3. TYPE I TEST METHODS

3.1. EXTERNALLY CHARGEABLE (OVC HEV) WITHOUT AN OPERATING MODE SWITCH

3.1.1. Two tests shall be performed under the following conditions:

Condition A: test shall be carried out with a fully charged electrical energy/power storage device.

Condition B: test shall be carried out with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity).

The profile of the state of charge (SOC) of the electrical energy/power storage device during different stages of the Type I test is given in Appendix 1.

3.1.2. Condition A

3.1.2.1. The procedure shall start with the discharge of the electrical energy/power storage device of the vehicle while driving (on the test track, on a chassis dynamometer, etc.):

- (a) at a steady speed of 50 km/h until the fuel consuming engine of the HEV starts up,
- (b) or, if a vehicle cannot reach a steady speed of 50 km/h without starting up the fuel consuming engine, the speed shall be reduced until the vehicle can run a lower steady speed where the fuel consuming engine does not start up for a defined time/distance (to be specified between technical service and manufacturer),
- (c) or with manufacturer's recommendation.

The fuel consuming engine shall be stopped within 10 seconds of it being automatically started.

3.1.2.2. Conditioning of vehicle

3.1.2.2.1. For compression-ignition engined vehicles, the Part Two cycle described in Appendix 1 of Annex 4 shall be used. Three consecutive cycles shall be driven according to paragraph 3.1.2.5.3. below.

3.1.2.2.2. Vehicles fitted with positive-ignition engines shall be preconditioned with one Part One and two Part Two driving cycles according to paragraph 3.1.2.5.3. below.

- 3.1.2.3. After this preconditioning, and before testing, the vehicle shall be kept in a room in which the temperature remains relatively constant between 293 and 303 K (20 °C and 30 °C). This conditioning shall be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within ± 2 K of the temperature of the room, and the electrical energy/power storage device is fully charged as a result of the charging prescribed in paragraph 3.1.2.4. below.
- 3.1.2.4. During soak, the electrical energy/power storage device shall be charged:
- (a) with the on board charger if fitted, or
 - (b) with an external charger recommended by the manufacturer, using the normal overnight charging procedure.

This procedure excludes all types of special charges that could be automatically or manually initiated like, for instance, the equalization charges or the servicing charges.

The manufacturer shall declare that during the test, a special charge procedure has not occurred.

- 3.1.2.5. Test procedure
- 3.1.2.5.1. The vehicle shall be started up by the means provided for normal use to the driver. The first cycle starts on the initiation of the vehicle start-up procedure.
- 3.1.2.5.2. **The test procedures defined in either paragraph 3.1.2.5.2.1. or 3.1.2.5.2.2. may be used in line with the procedure chosen in Regulation No. 101, Annex 8, paragraph 3.2.3.2.**
- 3.1.2.5.2.1.** Sampling shall begin (BS) before or at the initiation of the vehicle start up procedure and end on conclusion of the final idling period in the extra-urban cycle (Part Two, end of sampling (ES)).
- 3.1.2.5.2.2.** **Sampling shall begin (BS) before or at the initiation of the vehicle start up procedure and continue over a number of repeat test cycles. It shall end on conclusion of the final idling period in the first extra-urban (Part Two) cycle during which the battery reached the minimum state of charge according to the criterion defined below (end of sampling (ES)).**

The electricity balance Q [Ah] is measured over each combined cycle, using the procedure specified in Appendix 2 to this annex, and used to determine when the battery minimum state of charge has been reached.

The battery minimum state of charge is considered to have been reached in combined cycle N if the electricity balance measured during combined cycle N+1 is not more than a 3 per cent discharge, expressed as a percentage of the nominal capacity of the battery (in Ah) in its minimum state of charge, as

declared by the manufacturer. At the manufacturer's request additional test cycles may be run and their results included in the calculations in paragraphs 3.1.2.5.5. and 3.1.4.2. provided that the electricity balance for each additional test cycle shows less discharge of the battery than over the previous cycle.

In between each of the cycles a hot soak period of up to 10 minutes is allowed. The power train shall be switched off during this period.

- 3.1.2.5.3. The vehicle shall be driven according to Annex 4, or in case of special gear shifting strategy according to the manufacturer's instructions, as incorporated in the drivers' handbook of production vehicles and indicated by a technical gear shift instrument (for drivers information). For these vehicles the gear shifting points prescribed in Annex 4, Appendix 1 are not applied. For the pattern of the operating curve the description according to paragraph 2.3.3. in Annex 4 shall apply.
- 3.1.2.5.4. The exhaust gases shall be analyzed according to Annex 4.
- 3.1.2.5.5. The test results shall be compared to the limits prescribed in paragraph 5.3.1.4. of this Regulation and the average emission of each pollutant **in grams per kilometre** for Condition A shall be calculated (M_{1i}).

In the case of testing according to paragraph 3.1.2.5.2.1., (M_{1i}) is simply the result of the single combined cycle run.

In the case of testing according to paragraph 3.1.2.5.2.2., the test result of each combined cycle run (M_{1ia}), multiplied by the appropriate deterioration and K_i factors, shall be less than the limits prescribed in paragraph 5.3.1.4. of this Regulation. For the purposes of the calculation in paragraph 3.1.4 M_{1i} shall be defined as:

$$M_{1i} = \frac{1}{N} \sum_{a=1}^N M_{1ia}$$

where:

i : pollutant

a: cycle

- 3.1.3. Condition B
- 3.1.3.1. Conditioning of vehicle
- 3.1.3.1.1. For compression-ignition engined vehicles the Part Two cycle described in Appendix 1 of Annex 4 shall be used. Three consecutive cycles shall be driven according to paragraph 3.1.3.4.3. below.

- 3.1.3.1.2. Vehicles fitted with positive-ignition engines shall be preconditioned with one Part One and two Part Two driving cycles according to paragraph 3.1.3.4.3. below.
- 3.1.3.2. The electrical energy/power storage device of the vehicle shall be discharged while driving (on the test track, on a chassis dynamometer, etc.):
- (a) at a steady speed of 50 km/h until the fuel consuming engine of the HEV starts up,
 - (b) or if a vehicle can not reach a steady speed of 50 km/h without starting up the fuel consuming engine, the speed shall be reduced until the vehicle can run a lower steady speed where the fuel consuming engine just does not start up for a defined time/distance (to be specified between technical service and manufacturer),
 - (c) or with manufacturer's recommendation.
- The fuel consuming engine shall be stopped within 10 seconds of it being automatically started.
- 3.1.3.3. After this preconditioning, and before testing, the vehicle shall be kept in a room in which the temperature remains relatively constant between 293 and 303 K (20 °C and 30 °C). This conditioning shall be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within ± 2 K of the temperature of the room.
- 3.1.3.4. Test procedure
- 3.1.3.4.1. The vehicle shall be started up by the means provided for normal use to the driver. The first cycle starts on the initiation of the vehicle start-up procedure.
- 3.1.3.4.2. Sampling shall begin (BS) before or at the initiation of the vehicle start up procedure and end on conclusion of the final idling period in the extra-urban cycle (Part Two, end of sampling (ES)).
- 3.1.3.4.3. The vehicle shall be driven according to Annex 4, or in case of special gear shifting strategy according to the manufacturer's instructions, as incorporated in the drivers' handbook of production vehicles and indicated by a technical gear shift instrument (for drivers information). For these vehicles the gear shifting points prescribed in Annex 4, Appendix 1 are not applied. For the pattern of the operating curve the description according to paragraph 2.3.3. in Annex 4 shall apply.
- 3.1.3.4.4. The exhaust gases shall be analyzed according to Annex 4.
- 3.1.3.5. The test results shall be compared to the limits prescribed in paragraph 5.3.1.4. of this Regulation and the average emission of each pollutant for Condition B shall be calculated (M_{2i}). **The test results M_{2i} , multiplied by the appropriate**

deterioration and K_i factors, shall be less than the limits prescribed in paragraph 5.3.1.4. of this Regulation.

3.1.4. Test results

3.1.4.1. **In the case of testing according to paragraph 3.1.2.5.2.1.**

For communication, the weighted values shall be calculated as below

$$M_i = (D_e \cdot M_{1i} + D_{av} \cdot M_{2i}) / (D_e + D_{av})$$

where:

- M_i = mass emission of the pollutant i in grams per kilometre.
- M_{1i} = average mass emission of the pollutant i in grams per kilometre with a fully charged electrical energy/power storage device calculated in paragraph 3.1.2.5.5.
- M_{2i} = average mass emission of the pollutant i in grams per kilometre with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity) calculated in paragraph 3.1.3.5.
- D_e = vehicle electric range, according to the procedure described in Regulation No. 101, **Annex 9**, where the manufacturer must provide the means for performing the measurement with the vehicle running in pure electric mode.
- D_{av} = 25 km (average distance between two battery recharges)

3.1.4.2. **In the case of testing according to paragraph 3.1.2.5.2.2.**

For communication, the weighted values shall be calculated as below:

$$M_i = (D_{ovc} \cdot M_{1i} + D_{av} \cdot M_{2i}) / (D_{ovc} + D_{av})$$

where:

- M_i = mass emission of the pollutant i in grams per kilometre.
- M_{1i} = average mass emission of the pollutant i in grams per kilometre with a fully charged electrical energy/power storage device calculated in paragraph 3.1.2.5.5.
- M_{2i} = average mass emission of the pollutant i in grams per kilometre with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity) calculated in paragraph 3.1.3.5.
- D_{ovc} = OVC range according to the procedure described in Regulation No. 101, **Annex 9**.
- D_{av} = 25 km (average distance between two battery recharges).

3.2. EXTERNALLY CHARGEABLE (OVC HEV) WITH AN OPERATING MODE SWITCH

3.2.1. Two tests shall be performed under the following conditions:

3.2.1.1. Condition A: test shall be carried out with a fully charged electrical energy/power storage device.

3.2.1.2. Condition B: test shall be carried out with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity)

3.2.1.3. The operating mode switch shall be positioned according the table below:

Battery state of charge \ Hybrid-modes	-Pure electric -Hybrid	-Pure fuel consuming -Hybrid	-Pure electric -Pure fuel consuming -Hybrid	-Hybrid mode n (1) -Hybrid mode m (1)
	Switch in position	Switch in position	Switch in position	Switch in position
Condition A Fully charged	Hybrid	Hybrid	Hybrid	Most electric hybrid mode (2)
Condition B Min. state of charge	Hybrid	Fuel consuming	Fuel consuming	Most fuel consuming mode (3)

Notes:

(1) For instance: sport, economic, urban, extra-urban position ...

(2) Most electric hybrid mode:

The hybrid mode which can be proven to have the highest electricity consumption of all selectable hybrid modes when tested in accordance with condition A of paragraph 4. of Annex 10 to Regulation No. 101, to be established based on information provided by the manufacturer and in agreement with the technical service.

(3) Most fuel consuming mode:

The hybrid mode which can be proven to have the highest fuel consumption of all selectable hybrid modes when tested in accordance with condition B of paragraph 4. of Annex 10 to Regulation No. 101, to be established based on information provided by the manufacturer and in agreement with the technical service.

3.2.2. Condition A

3.2.2.1. If the pure electric range of the vehicle is higher than one complete cycle, on the request of the manufacturer, the Type I test may be carried out in pure electric mode. In this case, engine preconditioning prescribed in paragraph 3.2.2.3.1. or 3.2.2.3.2. can be omitted.

- 3.2.2.2. The procedure shall start with the discharge of the electrical energy/power storage device of the vehicle while driving with the switch in pure electric position (on the test track, on a chassis dynamometer, etc.) at a steady speed of 70 per cent \pm 5 per cent of the maximum thirty minutes speed of the vehicle (determined according to Regulation No. 101).

Stopping the discharge occurs:

- (a) when the vehicle is not able to run at 65 per cent of the maximum thirty minutes speed; or
- (b) when an indication to stop the vehicle is given to the driver by the standard on-board instrumentation, or
- (c) after covering the distance of 100 km.

If the vehicle is not equipped with a pure electric mode, the electrical energy/power storage device discharge shall be achieved by driving the vehicle (on the test track, on a chassis dynamometer, etc.):

- (a) at a steady speed of 50 km/h until the fuel consuming engine of the HEV starts up, or
- (b) if a vehicle cannot reach a steady speed of 50 km/h without starting up the fuel consuming engine, the speed shall be reduced until the vehicle can run a lower steady speed where the fuel consuming engine does not start up for a defined time/distance (to be specified between technical service and manufacturer), or
- (c) with manufacturer's recommendation.

The fuel consuming engine shall be stopped within 10 seconds of it being automatically started.

3.2.2.3. Conditioning of vehicle

- 3.2.2.3.1. For compression-ignition engined vehicles the Part Two cycle described in Appendix 1 to the Annex 4 shall be used. Three consecutive cycles shall be driven according to paragraph 3.2.2.6.3. below.

- 3.2.2.3.2. Vehicles fitted with positive-ignition engines shall be preconditioned with one Part One and two Part Two driving cycles according to paragraph 3.2.2.6.3. below.

- 3.2.2.4. After this preconditioning, and before testing, the vehicle shall be kept in a room in which the temperature remains relatively constant between 293 and 303 K (20 °C and 30 °C). This conditioning shall be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within \pm 2 K of the temperature of the room, and the electrical energy/power storage device is fully charged as a result of the charging prescribed in paragraph 3.2.2.5.

- 3.2.2.5. During soak, the electrical energy/power storage device shall be charged:
- (a) with the on board charger if fitted, or

- (b) with an external charger recommended by the manufacturer, using the normal overnight charging procedure.

This procedure excludes all types of special charges that could be automatically or manually initiated like, for instance, the equalisation charges or the servicing charges.

The manufacturer shall declare that during the test, a special charge procedure has not occurred.

3.2.2.6. Test procedure

3.2.2.6.1. The vehicle shall be started up by the means provided for normal use to the driver. The first cycle starts on the initiation of the vehicle start-up procedure.

3.2.2.6.2. **The test procedures defined in either paragraph 3.2.2.6.2.1. or 3.2.2.6.2.2. may be used in line with the procedure chosen in Regulation No. 101, Annex 8, paragraph 4.2.4.2.**

3.2.2.6.2.1. **Sampling shall begin (BS) before or at the initiation of the vehicle start up procedure and end on conclusion of the final idling period in the extra-urban cycle (Part Two, end of sampling (ES)).**

3.2.2.6.2.2. **Sampling shall begin (BS) before or at the initiation of the vehicle start up procedure and continue over a number of repeat test cycles. It shall end on conclusion of the final idling period in the first extra-urban (Part Two) cycle during which the battery has reached the minimum state of charge according to the criterion defined below (end of sampling (ES)).**

The electricity balance Q [Ah] is measured over each combined cycle, using the procedure specified in Appendix 2 to this annex, and used to determine when the battery minimum state of charge has been reached.

The battery minimum state of charge is considered to have been reached in combined cycle N if the electricity balance measured during combined cycle $N+1$ is not more than a 3 per cent discharge, expressed as a percentage of the nominal capacity of the battery (in Ah) in its minimum state of charge, as declared by the manufacturer. At the manufacturer's request additional test cycles may be run and their results included in the calculations in paragraphs 3.2.2.7. and 3.2.4.3. provided that the electricity balance for each additional test cycle shows less discharge of the battery than over the previous cycle.

In between each of the cycles a hot soak period of up to 10 minutes is allowed. The power train shall be switched off during this period

- 3.2.2.6.3. The vehicle shall be driven according to Annex 4, or in case of special gear shifting strategy according to the manufacturer's instructions, as incorporated in the drivers' handbook of production vehicles and indicated by a technical gear shift instrument (for drivers information). For these vehicles the gear shifting points prescribed in Annex 4, Appendix 1 are not applied. For the pattern of the operating curve the description according to paragraph 2.3.3. in Annex 4 shall apply.
- 3.2.2.6.4. The exhaust gases shall be analysed according to Annex 4.
- 3.2.2.7. The test results shall be compared to the limits prescribed in paragraph 5.3.1.4. of this Regulation and the average emission of each pollutant **in grams per kilometre** for Condition A shall be calculated (M_{ij}).

In the case of testing according to paragraph 3.2.2.6.2.1., (M_{ij}) is simply the result of the single combined cycle run.

In the case of testing according to paragraph 3.2.2.6.2.2., the test result of each combined cycle run M_{1ia} , multiplied by the appropriate deterioration and K_i factors, shall be less than the limits prescribed in paragraph 5.3.1.4. of this Regulation. For the purposes of the calculation in paragraph 3.2.4., M_{1i} shall be defined as:

$$M_{1i} = \frac{1}{N} \sum_{a=1}^N M_{1ia}$$

where:

i : pollutant

a: cycle

- 3.2.3. Condition B
- 3.2.3.1. Conditioning of vehicle
- 3.2.3.1.1. For compression-ignition engines the Part Two cycle described in Appendix 1 to the Annex 4 shall be used. Three consecutive cycles shall be driven according to paragraph 3.2.3.4.3. below.
- 3.2.3.1.2. Vehicles fitted with positive-ignition engines shall be preconditioned with one Part One and two Part Two driving cycles according to paragraph 3.2.3.4.3. below.
- 3.2.3.2. The electrical energy/power storage device of the vehicle shall be discharged according to paragraph 3.2.2.2.
- 3.2.3.3. After this preconditioning, and before testing, the vehicle shall be kept in a room in which the temperature remains relatively constant between 293 and 303 K

(20 °C and 30 °C). This conditioning shall be carried out for at least six hours and continue until the engine oil temperature and coolant, if any, are within ± 2 K of the temperature of the room.

3.2.3.4. Test procedure

3.2.3.4.1. The vehicle shall be started up by the means provided for normal use to the driver. The first cycle starts on the initiation of the vehicle start-up procedure.

3.2.3.4.2. Sampling shall begin (BS) before or at the initiation of the vehicle start up procedure

and end on conclusion of the final idling period in the extra-urban cycle (Part Two, end of sampling (ES)).

3.2.3.4.3. The vehicle shall be driven according to Annex 4, or in case of special gear shifting strategy according to the manufacturer's instructions, as incorporated in the drivers' handbook of production vehicles and indicated by a technical gear shift instrument (for drivers information). For these vehicles the gear shifting points prescribed in Annex 4, Appendix 1 are not applied. For the pattern of the operating curve the description according to paragraph 2.3.3. in Annex 4 shall apply.

3.2.3.4.4. The exhaust gases shall be analysed according to Annex 4.

3.2.3.5. The test results shall be compared to the limits prescribed in paragraph 5.3.1.4. of this Regulation and the average emission of each pollutant for Condition B shall be calculated (M_{2i}). **The test results M_{2i} , multiplied by the appropriate deterioration and K_i factors, shall be less than the limits prescribed in paragraph 5.3.1.4. of this Regulation.**

3.2.4. Test results

3.2.4.1. **In the case of testing according to paragraph 3.2.2.6.2.1.**

For communication, the weighted values shall be calculated as below:

$$M_i = (De \cdot M_{1i} + Dav \cdot M_{2i}) / (De + Dav)$$

where :

M_i = mass emission of the pollutant i in grams per kilometre

M_{1i} = average mass emission of the pollutant i in grams per kilometre with a fully charged electrical energy/power storage device calculated in paragraph 3.2.2.7.

M_{2i} = average mass emission of the pollutant i in grams per kilometre with an electrical energy/power storage device in minimum state of

charge (maximum discharge of capacity) calculated in paragraph 3.2.3.5.

D_e = vehicle electric range with the switch in pure electric position, according to the procedure described in Regulation No. 101, **Annex 9**. If there is not a pure electric position, the manufacturer must provide the means for performing the measurement with the vehicle running in pure electric mode.

D_{av} = 25 km (average distance between two battery recharge).

3.2.4.2. In the case of testing according to paragraph 3.2.2.6.2.2.

For communication, the weighted values shall be calculated as below

$$M_i = (D_{ovc} \cdot M_{1i} + D_{av} \cdot M_{2i}) / (D_{ovc} + D_{av})$$

where:

M_i = mass emission of the pollutant i in grams per kilometre.

M_{1i} = average mass emission of the pollutant i in grams per kilometre with a fully charged electrical energy/power storage device calculated in paragraph 3.2.2.7.

M_{2i} = average mass emission of the pollutant i in grams per kilometre with an electrical energy/power storage device in minimum state of charge (maximum discharge of capacity) calculated in paragraph 3.2.3.5.

D_{ovc} = OVC range according to the procedure described in Regulation No. 101, **Annex 9**.

D_{av} = 25 km (average distance between two battery recharges)"

B. JUSTIFICATION

Annex 14 of Regulation No. 83 specifies test procedures for hybrid vehicles, including externally chargeable, or 'Off Vehicle Charging' (OVC) vehicles. This proposal amends test procedures for these vehicles to align them with proposals being made to amend Regulation No. 101 (fuel consumption and CO₂) to better reflect the real world CO₂ benefits of certain of these vehicles.

The proposal introduces a new test procedure as an option to that currently used. The new procedure involves repeat testing of the vehicle from the maximum state of battery charge condition until the minimum state of battery charge is reached. The average result from these repeat NEDC cycles is used in calculating the weighted average pollutant emissions. Following the initial, cold start, test cycle in the maximum state of charge condition subsequent cycles are hot start tests to avoid excessive test burden. In order to prevent this resulting in a reduction in stringency of the standards, the above proposal requires that the emissions limits must be met under all individual test cycles, including the initial, cold start, maximum state of charge test cycle and the cold start minimum state of charge test.

The above proposal makes use of the OVC range, defined in the proposal to amend Regulation No. 101 as the distance travelled in the number of complete NEDC cycles that can be driven before the battery reaches a stable minimum state of charge.
