



Economic and Social Council

Distr.: General
17 March 2021

Original: English

Economic Commission for Europe

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

Working Party on Pollution and Energy

Eighty-third session

Geneva, 1-4 June 2021

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 Regulation No. 101 (CO₂ emissions/fuel consumption)

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). This document proposes to introduce the shortened test procedure for PEVs as well as an update of the COP test procedure in order to align UN Regulation No. 101 with proceeding and procedures described in UN Regulation No. 154. It also proposes an option for manufacturers to determine road load values for Pure Electric Vehicles according to the requirements of UN Regulation No. 83. The modifications to the current text of the Regulation are marked in bold for new or strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2021 as outlined in proposed programme budget for 2021 (A/75/6 (Sect.20), para 20.51), 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.



I. Proposal

Paragraph 2.18., amend to read:

- “2.18. “*Electric range*”, for vehicles powered by an electric power train only or by a hybrid electric power train with off-vehicle charging, means distance that can be driven electrically on one fully charged battery (or other electric energy storage device) as measured according to the procedure described in **Annex 7 and Annex 9** to this Regulation.”

Paragraph 5.3.1., amend to read:

- “5.3.1. The Technical Service in charge of the tests conducts the measurement of the electric energy consumption **and electric range** according to the method and test cycle described in Annex 7 to this Regulation.”

Paragraph 5.3.2., delete first subparagraph and amend second subparagraph to read:

- “5.3.2. ~~The Technical Service in charge of the tests conducts the measurement of the electric range of the vehicle according to the method described in Annex 9 to this Regulation.~~

The **pure** electric range **D_e** measured by this method is the only one which may be included in sales promotional material.”

Paragraph 5.3.3., amend to read:

- “5.3.3. The result of the electric energy consumption **C** must be expressed in Watt hours per kilometre (Wh/km) and the range in km, both rounded to the nearest whole number.”

Paragraph 9.4.1.5., amend to read:

- “9.4.1.5. Make sure that for each type of vehicle, **the electric energy consumption testing** prescribed in Annex 7 to this Regulation is carried out; notwithstanding the requirements of paragraph **5.1.1.6.** of Annex 7 to this Regulation, at the request of the manufacturer, the tests will be carried out on vehicles which have not travelled any distance; **as an alternative at the choice of the manufacturer, the electric energy consumption may confirmed by testing according to the procedure that is described in paragraph 9.4.3. below.**

~~Make sure that for each type of vehicle tests prescribed in Annex 7 to this Regulation is carried out; notwithstanding the requirements of paragraph 2.3.1.6. of Annex 7 to this Regulation, at the request of the manufacturer, the tests will be carried out on vehicles which have not travelled any distance.”~~

Add Paragraph 9.4.3. and subparagraphs 9.4.3.1. up to 9.4.3.5.:

- “**9.4.3. Alternative at the choice of the manufacturer for electric energy consumption verification for conformity of production**

- 9.4.3.1. During the conformity of production procedure, the break-off criterion for the Type 1 test procedure according to paragraph 5.2.3.1. to Annex 7 of this Regulation (consecutive cycle procedure) and paragraph 5.2.3.2. to Annex 7 of this Regulation (Shortened Test Procedure) shall be replaced with the following:**

The break-off criterion for the conformity of production procedure shall be reached with having finished the first two NEDC test cycles according to paragraph 2. to Annex 7 of this Regulation.

- 9.4.3.2. During this first two NEDC test cycle, the DC energy from the REESS(s) shall be measured according to the method described in Appendix 2 to Annex 7 of this Regulation and divided by the driven distance in this two NEDC test cycles.**

- 9.4.3.3. The value determined according to paragraph 9.4.3.2. shall be compared to the value determined according to paragraph 9.4.3.5..
- 9.4.3.4. Conformity for electric energy consumption shall be checked using the statistical procedures described in Section 9.3.. For the purposes of this conformity check, the term CO₂ shall be replaced by electric energy consumption.
- 9.4.3.5. Electric energy consumption for vehicles powered by an electric power train only

The following value shall be declared and used for verifying the conformity of production with respect to the electric consumption:

$$EC_{DC,COP} = EC_{DC,first\ two\ NEDC} \times AF_{EC}$$

where:

$EC_{DC,COP}$ is the value for electric energy consumption that has to be confirmed during the conformity of production test procedure within the first two NEDC test cycles, in Wh/km;

$EC_{DC,first\ two\ NEDC}$ is the electric energy consumption of the first two NEDC test cycles calculated according to paragraph 5.2.5.1. to Annex 7 for type approval purposes, in Wh/km;

AF_{EC} is the adjustment factor that adjusts the electric energy consumption that has to be confirmed in COP based on the difference between calculated and declared electric energy consumption for type approval purposes.

and:

$$AF_{EC} = \frac{C_{dec}}{C}$$

where:

C_{dec} is the declared electric energy consumption according to Section 5.5. in Wh/km;

C is the electric energy consumption according to paragraph 5.2.5.3. to Annex 7, in Wh/km.”

Annex 7, amend the title to read.:

“Method of measuring the electric energy consumption and the pure electric range of vehicles powered by an electric power train only”

Annex 7, insert new paragraphs 1., 1.1. and 1.2. to read:

- “1. **Measurement of electric energy consumption and pure electric range**
- The test method described hereafter permits to measure the electric energy consumption, expressed in Wh/km, and the pure electric range, expressed in km, of vehicles powered by an electric power train only.
- 1.1. The test procedure to determine the pure electric range and electric energy consumption shall be selected in accordance with the estimated pure electric range of the test vehicle from the following table.

If the estimated pure electric range is	Applicable test procedure
...less than the length of 6 NEDC test cycles.	Consecutive cycle test procedure in accordance with paragraph 5.2.3.1. of this Annex.
...equal to or greater than the length of 6 NEDC test cycles.	Shortened test procedure in accordance with paragraph 5.2.3.2. of this Annex.

The manufacturer shall give evidence to the approval authority concerning the estimated pure electric range prior to the test. The pure electric range determined by the applied test procedure shall confirm that the correct test procedure was applied.

1.2. Parameters, units and accuracy of measurements

<i>Parameter</i>	<i>Units</i>	<i>Accuracy</i>	<i>Resolution</i>
Time	s	±0.1 s	0.1 s
Distance	m	±0.1 per cent	1 m
Temperature	°C	±1 °C	1 °C
Speed	km/h	±1 per cent	0.2 km/h
Mass	kg	±0.5 per cent	1 kg
Electric Energy ^(a)	Wh	±1 per cent	0.001 kWh ^(b)
Electric current	A	±0.3 per cent FSD or ±1 per cent of reading ^(c,d)	0.1 A
Electric voltage	V	±0.3 per cent FSD or ±1 per cent of reading ^(c)	0.1 V

- (a) Equipment: static meter for active energy.
- (b) AC watt-hour meter, Class 1 according to IEC 62053-21 or equivalent.
- (c) Whichever is greater.
- (d) Current integration frequency 20 Hz or more.”

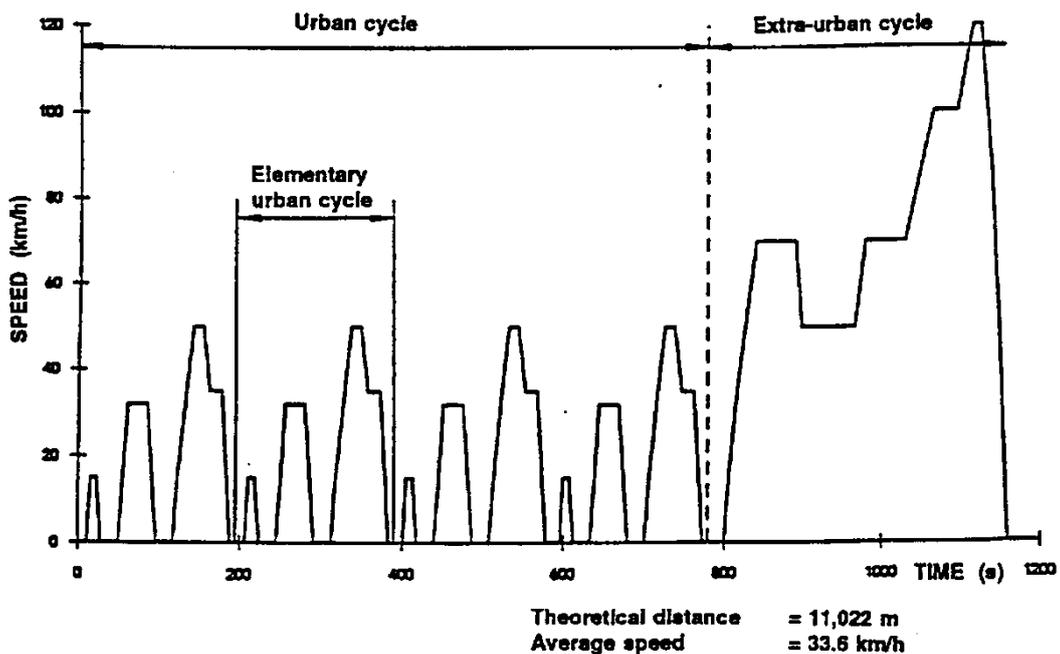
Annex 7, renumber paragraphs 1. to 1.3. as 2. to 2.3. and amend to read:

~~2.1.~~ NEDC test cycle ~~Test sequence~~

~~2.1.1.1.~~ Composition

The NEDC test cycle ~~test sequence~~ is composed of two parts (see Figure 1):

Figure 1
NEDC test cycle ~~Text sequence~~



~~2.2.1.2.~~ Urban cycle

~~2.3.1.3.~~ Extra-urban cycle”

Annex 7, insert new paragraph 3:

“3. Shortened NEDC test sequence

The shortened NEDC test sequence consists of two dynamic NEDC-segments (DS₁ and DS₂) combined with two constant speed segments (CSS_M and CSS_E) as shown in the following figure.

Figure 3a
Shortened NEDC test sequence



The dynamic NEDC segments DS₁ and DS₂ are used to calculate the electric energy consumption. The constant speed segments CSS_M and CSS_E are intended to reduce test duration by depleting the REESS more rapidly than driving consecutively NEDC test cycles.

3.1. Dynamic NEDC segments

Each dynamic NEDC segment DS₁ and DS₂ consists of two NEDC test cycles in accordance with paragraph 2. of this Annex.

3.2. Constant speed segment

The constant speeds during segments CSS_M and CSS_E shall be identical.

(a) Speed specification

The minimum speed of the constant speed segments shall be 100 km/h. At the request of manufacturer and with approval of the approval authority, a higher constant speed in the constant speed segments may be selected.

The acceleration to the constant speed level shall be smooth and accomplished within 1 minute after completion of the dynamic segments and, in the case of a break in accordance with paragraph 5.2.5.2.1. of this Annex, after initiating the powertrain start procedure.

If the maximum speed of the vehicle is lower than the required minimum speed for the constant speed segments according to the speed specification of this paragraph, the required speed in the constant speed segments shall be equal to the maximum speed of the vehicle.

(b) Distance determination of CSS_E and CSS_M

The length of the constant speed segment CSS_E shall be determined based on the percentage of the usable REESS energy UBE_{STP} according to paragraph 5.2.5.2.2. of this Annex. The remaining energy in the traction REESS after dynamic NEDC segment DS₂ shall be equal to or less than 10 per cent of UBE_{STP} . The manufacturer shall provide evidence to the approval authority after the test that this requirement is fulfilled.

The length of the constant speed segment CSS_M may be calculated using the following equation:

$$d_{CSSM} = D_{e,est} - d_{DS1} - d_{DS2} - d_{CSSE}$$

where:

$D_{e,est}$ is the estimated pure electric range of the considered vehicle, km;

d_{DS1} is the length of dynamic NEDC segment 1, km;

d_{DS2} is the length of dynamic NEDC segment 2, km;

d_{CSS_E} is the length of constant speed segment CSS_E , km.”

Annex 7, renumber paragraph 1.4. as 4. and amend to read:

“4.1.4. Tolerance

Tolerances are given in Figure 4.”

Annex 7, add new paragraph 4.1. and 4.2.:

“4.1. Tolerances for driving the NEDC test cycle

Tolerances are given in Figure 4.

4.2. Tolerances for driving with constant speed in a constant speed segment

Tolerances on the constant speed are ± 2 km/h.

Deviations beyond this tolerance are permitted up to five times per hour for a duration less than 4 seconds each.”

Annex 7, renumber paragraph 2. as 5.:

“5.2. Test method”

Annex 7, delete paragraph 2.1. and 2.2.:

“2.1. Principle

~~The test method described hereafter allows the electric energy consumption, expressed in Wh/km, to be measured:~~

~~2.2. Parameters, units and accuracy of measurements~~

<i>Parameter</i>	<i>Units</i>	<i>Accuracy</i>	<i>Resolution</i>
Time	s	± 0.1 s	0.1 s
Distance	m	± 0.1 per cent	1 m
Temperature	$^{\circ}\text{C}$	± 1 $^{\circ}\text{C}$	1 $^{\circ}\text{C}$
Speed	km/h	± 1 per cent	0.2 km/h
Mass	kg	± 0.5 per cent	1 kg
Energy	Wh	± 0.2 per cent	Class 0.2 s according to IEC 687

~~IEC = International Electrotechnical Commission”~~

Annex 7, renumber paragraph 2.3. to 2.3.1.6. as 5.1. to 5.1.1.6. and amend paragraph 5.1.1.6. to read:

“5.1.2.3. Vehicle

5.1.1.2.3.1. Condition of the vehicle

5.1.1.1.2.3.1.1. The vehicle tyres shall be inflated to the pressure specified by the vehicle manufacturer when the tyres are at the ambient temperature.

5.1.1.2.2.3.1.2. The viscosity of the oils for the mechanical moving parts shall conform to the specification of the vehicle manufacturer.

5.1.1.3.2.3.1.3. The lighting and light-signalling and auxiliary devices shall be off, except those required for testing and usual day-time operation of the vehicle.

5.1.1.4.2.3.1.4. All energy storage systems available for other than traction purposes (electric, hydraulic, pneumatic, etc.) shall be charged up to their maximum level specified by the manufacturer.

5.1.1.5.2.3.1.5. If the batteries are operated above the ambient temperature, the operator shall follow the procedure recommended by the car manufacturer in order to keep the temperature of the battery in the normal operating range.

The manufacturer's agent shall be in a position to attest that the thermal management system of the battery is neither disabled nor reduced.

- ~~5.1.1.6.2.3.1.6.~~ The vehicle must have undergone at least 300 km **or one full charge distance, whichever is longer**, before the test with those batteries that are installed in the test vehicle.”

Annex 7, renumber paragraph 2.4. as 5.2. and amend to read:

~~“5.2.2.4.~~ Operation mode

All the tests are conducted at a temperature of between 20 °C and 30 °C.

The **general** test method includes the ~~four~~ following steps:

- (a) **Discharging the battery in accordance with paragraph 5.2.1. of this Annex;**
- (b) **Application of a normal charge in accordance with paragraph 5.2.2. of this Annex;**
- (c) **Application of either the consecutive cycle test procedure or the shortened test procedure in accordance with paragraph 1.1. of this Annex;**
- (d) **Application of a normal charge in accordance with paragraph 5.2.2. of this Annex;**
- (e) **Determination of the electric energy consumption and the pure electric range.**

~~(a) — Initial charge of the battery;~~

~~(b) — Application twice of the cycle made of four elementary urban cycles and an extra urban cycle;~~

~~(c) — Charging the battery;~~

~~(d) — Calculation of the electric energy consumption.~~

Between the steps, if the vehicle shall move, it is pushed to the following test area (without regenerative recharging).

The chassis dynamometer shall be set with the method described in Appendix 1 to this Annex.”

Annex 7 delete paragraph 2.4.1.:

~~“2.4.1. — Initial charge of the battery~~

~~Charging the battery consists of the following procedures:”~~

Annex 7 renumber paragraph 2.4.1.1. to 2.4.1.2.2. as 5.2.1. to 5.2.2.2. and amend to read:

~~“5.2.1.2.4.1.1.~~ Discharge of the battery

The discharge procedure shall be performed according to the manufacturer’s recommendation. The manufacturer shall guarantee that the REESS is as fully depleted as is possible by the discharge procedure.

~~The procedure starts with the discharge of the battery of the vehicle while driving (on the test track, on a chassis dynamometer, etc.) at a steady speed of 70 per cent ± 5 per cent from the maximum thirty minutes speed of the vehicle.~~

~~Stopping the discharge occurs:~~

- ~~(a) — When the vehicle is not able to run at 65 per cent of the maximum thirty minutes speed;~~
- ~~(b) — Or 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.~~

~~5.2.2.2.4.1.2.~~ Application of a normal ~~overnight~~ charge

Normal charging is the transfer of electricity to an electrified vehicle with a power of less than or equal to 22 kW.

Where there are several possible methods to perform a normal AC charge (e.g. cable, induction, etc.), the charging procedure via cable shall be used.

Where there are several AC charging power levels available, the highest normal charging power shall be used. An AC charging power lower than the highest normal AC charging power may be selected if recommended by the manufacturer and by approval of the responsible authority.

~~The battery shall be charged according to the following procedure.~~

~~5.2.2.1.2.4.1.2.1.~~ **Charging procedure** ~~Normal overnight charge procedure~~

The REESS shall be charged at an ambient temperature compromised between 20°C and 30°C with the on-board charger if fitted.

In the following cases, a charger recommended by the manufacturer and using the charging pattern prescribed for normal charging shall be used if:

- (a) **No on-board charger is fitted, or**
- (b) **Charging time exceeds maximum time defined in paragraph 5.2.2.2.**

The procedures in this paragraph exclude all types of special charges that could be automatically or manually initiated, e.g. equalization charges or servicing charges.

~~The charge is carried out:~~

- ~~(a) — With the on board charger if fitted,~~
- ~~(b) — With an external charger recommended by the manufacturer, using the charging pattern prescribed for normal charging,~~
- ~~(c) — In an ambient temperature comprised between 20 °C and 30 °C.~~

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

~~5.2.2.2.2.4.1.2.2.~~ End of charge criteria

The end of charge criteria corresponds to a charging time of 12 hours except if a clear indication is given to the driver by the standard instrumentation that the battery is not yet fully charged.

In this case,

the maximum time is = $\frac{3 \cdot \text{claimed battery capacity (Wh)}}{\text{mains power supply (W)}}$ „

Annex 7, delete paragraph 2.4.1.2.3.:

~~“2.4.1.2.3. Fully charged battery~~

~~Battery having been charged according to overnight charge procedure until the end of charge criteria.”~~

Annex 7, renumber paragraph 2.4.2. as 5.2.3. and amend to read:

~~“5.2.3.2.4.2.~~ Application of the cycle **test procedure to determine the pure electric range and the electric energy consumption** ~~measurement of the distance~~

The end of charging time t_0 (plug off) is reported.

~~The chassis dynamometer shall be set with the method described in Appendix 1 to this annex.~~

~~Starting within 4 hours from t_0 , the cycle made of four elementary urban cycles and an extra-urban cycle is run twice on a chassis dynamometer (test distance: 22 km, test duration: 40 minutes).~~

~~At the end, the measure D_{test} of the covered distance in km is recorded.”~~

Annex 7, insert new paragraphs 5.2.3.1. to 5.2.3.2.3.:

“5.2.3.1. Consecutive cycle test procedure

5.2.3.1.1. Speed trace and breaks

The test shall be performed by driving consecutive NEDC test cycles until the break-off criterion according to paragraph 5.2.3.1.3. of this Annex is reached.

To respect human needs, up to three interruptions are permitted between NEDC test cycles, of no more than fifteen minutes in total.

Breaks for the driver and/or operator are permitted only between test cycles and with a maximum total break time of 10 minutes. During the break, the powertrain shall be switched off.

5.2.3.1.2. REESS current and voltage measurement

From the beginning of the test until the break-off criterion according to 5.2.3.1.3. is reached, the electric current of all REESSs and the electric voltage of all REESSs shall be determined according to Appendix 2 to this Annex.

5.2.3.1.3. Break-off criterion

The break-off criterion is reached when the vehicle is not able to meet the target curve up to 50 km/h, or when an indication from the standard on-board instrumentation is given to the driver to stop the vehicle.

The accelerator control shall be deactivated. The vehicle shall be braked to standstill within 60 seconds.

At a speed over 50 km/h, when the vehicle does not reach the required acceleration or speed of the test cycle, the accelerator pedal shall remain fully depressed until the reference curve has been reached again.

5.2.3.2. Shortened test procedure

5.2.3.2.1. Speed trace and breaks

The test shall be performed by driving the shortened NEDC test sequence according to paragraph 3. of this Annex until the break-off criterion according to paragraph 5.2.3.2.3. of this Annex is reached.

Breaks for the driver and/or operator are permitted only in the constant speed segments as prescribed in the following table.

Breaks for the driver and/or test operator

Distance driven in constant speed segment CSS_M (km)	Maximum total break (min)
Up to 100	10
Up to 150	20
Up to 200	30
Up to 300	60
More than 300	Shall be based on the manufacturer's recommendation

5.2.3.2.2. REESS current and voltage measurement

From the beginning of the test until the break-off criterion according to paragraph 5.2.3.2.3. to this Annex is reached, the electric current of all REESSs and the electric voltage of all REESSs shall be determined according to Appendix 2 to this Annex.

5.2.3.2.3. Break-off criterion

The break-off criterion is reached when the vehicle exceeds the prescribed speed trace tolerance as specified in paragraph 4.2. of this Annex for 4 consecutive seconds or more in the second constant speed segment CSS_E. The accelerator control shall be deactivated. The vehicle shall be braked to a standstill within 60 seconds.”

Annex 7, renumber paragraph 2.4.3. as 5.2.4. and amend to read:

~~5.2.4.2.4.3.~~ Charge of the battery

The vehicle shall be connected to the mains within the 30 minutes after the **break-off criterion in accordance with paragraph 5.2.3.1.3. or 5.2.3.2.3. respectively** ~~conclusion of the cycle made of four elementary urban cycles and an extra urban cycle, carried out twice.~~

The vehicle shall be charged according to normal overnight charge procedure **in accordance with paragraph 5.2.2. of this Annex** ~~(see paragraph 2.4.1.2. of this annex).~~

The energy measurement equipment, placed between the mains socket and the vehicle charger, measures the charge energy E delivered from the mains, as well as its duration.

The determination of recharged electric energy shall be stopped if the end of charge criterion in accordance with 5.2.2.2. is reached.

Charging is stopped after 24 hours from the previous end of charging time (t_0).

Note: ~~In case of a mains power cut, the 24 hours period will be extended accordingly to the cut duration. Validity of the charge will be discussed between the Technical Services of the approval laboratory and the vehicle's manufacturer.”~~

Annex 7, delete paragraph 2.4.4. and insert new paragraphs 5.2.5. to 5.2.5.3.:

~~2.4.4.~~ Electric energy consumption calculation

~~Energy E in Wh and charging time measurements are recorded in the test report.~~

~~The electric energy consumption c is defined by the formula:~~

$$c = \frac{E}{D_{\text{test}}} \text{ (expressed in Wh/km and rounded to the nearest whole number)}$$

~~Where D_{test} is the distance covered during the test (km).~~

5.2.5. Determination of pure electric range and electric energy consumption**5.2.5.1. Calculation of electric energy consumption**

For the determination of the electric energy consumption based on the current and voltage determined according to Appendix 2 of this Annex, the following equations shall be used:

$$EC_{DC,j} = \frac{\Delta E_{REESS,j}}{d_j}$$

where:

$EC_{DC,j}$ is the electric energy consumption over the considered period j based on the REESS depletion, Wh/km;

$\Delta E_{REESS,j}$ is the electric energy change of all REESSs during the considered period j , Wh;

d_j is the distance driven in the considered period j , km;

and

$$\Delta E_{REESS,j} = \sum_{i=1}^n \Delta E_{REESS,j,i}$$

where:

$\Delta E_{REESS,j,i}$ is the electric energy change of REESS i during the considered period j , Wh;

and

$$\Delta E_{REESS,j,i} = \frac{1}{3600} \times \int_{t_0}^{t_{end}} U(t)_{REESS,j,i} \times I(t)_{REESS,j,i} dt$$

where:

$U(t)_{REESS,j,i}$ is the voltage of REESS i during the considered period j determined according to Appendix 2 to this Annex, V;

t_0 is the time at the beginning of the considered period j , s;

t_{end} is the time at the end of the considered period j , s;

$I(t)_{REESS,j,i}$ is the electric current of REESS i during the considered period j determined according to Appendix 2 to this Annex, A;

i is the index number of the considered REESS;

n is the total number of REESS;

j is the index for the considered period, where a period can be any combination of phases or cycles;

$\frac{1}{3600}$ is the conversion factor from Ws to Wh.

5.2.5.2. Calculation of the pure electric range

5.2.5.2.1. Determination of the pure electric range when the consecutive cycle test procedure according to paragraph 5.2.3.1. of this Annex is applied

The final pure electric range D_e shall rounded to the nearest whole number in km and shall be calculated using the following equations:

$$D_e = \frac{UBE_{CCP}}{EC_{DC}}$$

where:

UBE_{CCP} is the usable REESS energy determined from the beginning of the consecutive cycle test procedure until the break-off criterion according to paragraph 5.2.3.1.3. of this Annex is reached, Wh;

EC_{DC} is the electric energy consumption determined from completely driven NEDC 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 NEDC test cycle j of the consecutive cycle test procedure, Wh;

j is the index number of the NEDC test cycle considered;

k is the number of NEDC test cycles driven from the beginning up to and including the phase where the break-off criterion is reached;

and

$$EC_{DC} = \sum_{j=1}^n EC_{DC,j} \times k_j$$

where:

$EC_{DC,j}$ is the electric energy consumption for NEDC test cycle j of the consecutive cycle test procedure according to paragraph 5.2.5.1. of this Annex, Wh/km;

k_j is the weighting factor for the NEDC test cycle j of the consecutive cycle test procedure;

j is the index number of the NEDC test cycle;

n is the whole number of complete NEDC test cycles driven;

and

in case of two complete NEDC test cycles driven:

$$k_1 = \frac{\Delta E_{REESS,1}}{UBE_{CCP}}, k_2 = \frac{\Delta E_{REESS,2}}{UBE_{CCP}}$$

in case of at least three NEDC test cycles driven:

$$k_1 = \frac{\Delta E_{REESS,1}}{UBE_{CCP}}, k_2 = \frac{\Delta E_{REESS,2}}{UBE_{CCP}} \text{ and } k_j = \frac{1-k_1-k_2}{n-2} \text{ for } j = 3 \dots n$$

where:

$\Delta E_{REESS,1}$ is the electric energy change of all REESSs during the first NEDC test cycle of the consecutive test cycle procedure, Wh;

$\Delta E_{REESS,2}$ is the electric energy change of all REESSs during the second NEDC test cycle of the consecutive test cycle procedure, Wh.

5.2.5.2.2. Determination of the pure electric range when the shortened test procedure according to paragraph 5.2.3.2. of this Annex is applied

The final pure electric range D_e shall rounded to the nearest whole number in km and shall be calculated using the following equations:

$$D_e = \frac{UBE_{STP}}{EC_{DC}}$$

where:

UBE_{STP} is the usable REESS energy determined from the beginning of the shortened test procedure until the break-off criterion as defined in paragraph 5.2.3.2.3. of this Annex is reached, Wh;

EC_{DC} is the weighted electric energy consumption of DS₁ and DS₂ of the shortened test procedure, 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 DS₁ of the shortened test procedure, Wh;

$\Delta E_{REESS,DS_2}$ is the electric energy change of all REESSs during DS₂ of the shortened test procedure, Wh;

$\Delta E_{REESS,CSS_M}$ is the electric energy change of all REESSs during CSS_M of the shortened test procedure, Wh;

$\Delta E_{REESS,CSS_E}$ is the electric energy change of all REESSs during CSS_E of the shortened test procedure, Wh;

and

$$EC_{DC} = \sum_{j=1}^2 EC_{DC,j} \times k_j$$

where:

$EC_{DC,j}$ is the electric energy consumption of DS_j of the shortened test procedure according to paragraph 5.2.5.1. of this Annex, Wh/km;

k_j is the weighting factor of DS_j of the shortened test procedure;

and

$$k_1 = \frac{\Delta E_{REESS,DS_1}}{UBE_{STP}} \quad \text{and} \quad k_2 = 1 - k_1$$

where:

k_1 is the weighting factor of DS₁ of the shortened test procedure;

k_2 is the weighting factor of DS₂ of the shortened test procedure;

$\Delta E_{REESS,DS_1}$ is the electric energy change of all REESSs during DS₁ of the shortened test procedure, Wh;

5.2.5.3. Calculation of electric energy consumption

The electric energy consumption based on the recharged electric energy from the mains and the pure electric range shall be calculated using the following equation:

$$C = \frac{E_{AC}}{D_e}$$

where:

C the electric energy consumption rounded to the nearest whole number based on the recharged electric energy from the mains and the non-rounded pure electric range, Wh/km;

E_{AC} is the recharged electric energy from the mains according to paragraph 5.2.4. of this Annex, Wh;

D_e is the non-rounded pure electric range as calculated according to paragraph 5.2.5.2.1. or paragraph 5.2.5.2.2. of this Annex, depending on the PEV test procedure that must be used according to paragraph 1.1. of this Annex, km.”

Annex 7, Appendix 1, paragraph 1.; amend to read:

“1. Introduction

The purpose of this appendix is to define the method of measuring the total road load power of a vehicle with a statistical accuracy of ± 4 per cent at a constant speed and to reproduce this measured road load power on a dynamometer with an accuracy of ± 5 per cent.

As an alternative at the choice of the manufacturer, the road load may be determined according to the process described in Appendix 7 to Annex 4a of the latest version of UN Regulation No. 83 at the time of approval.”

Add new Annex 7, Appendix 3:

“Annex 7 - Appendix 3

Determination of REESS current and REESS voltage PEVs

1. Introduction

1.1. This Appendix defines the method and required instrumentation to determine the REESS current and the REESS voltage of PEVs.

1.2. Measurement of REESS current and REESS voltage shall start at the same time as the test starts and shall end immediately after the vehicle has finished the test.

1.3. A list of the instrumentation used by the manufacturer to measure REESS voltage and current (including instrument manufacturer, model number, serial number, last calibration dates (where applicable)) shall be provided to the approval authority.

2. REESS current

REESS depletion is considered as a negative current.

2.1. External REESS current measurement

2.1.1. The REESS current(s) shall be measured during the tests using a clamp-on or closed type current transducer. The current measurement system shall fulfil the requirements specified in paragraph 1.2. of this Annex. The current transducer(s) shall be capable of handling the peak currents and temperature conditions at the point of measurement.

In order to have an accurate measurement, zero adjustment and degaussing shall be performed before the test in accordance with the instrument manufacturer's instructions.

2.1.2. Current transducers shall be fitted to any of the REESS on one of the cables connected directly to the REESS and shall include the total REESS current.

In case of shielded wires, appropriate methods shall be applied in accordance with the approval authority.

In order to easily measure the REESS current using external measuring equipment, the manufacturer should provide appropriate, safe and accessible connection points in the vehicle. If that is not feasible, the manufacturer is obliged to support the approval authority in connecting a current transducer to one of the cables directly connected to the REESS in the manner described above in this paragraph.

2.1.3. The current transducer output shall be sampled with a minimum frequency of 20 Hz. 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.

2.2. Vehicle on-board REESS current data

As an alternative to paragraph 2.1. of this Appendix, the manufacturer may use the on-board current measurement data. The accuracy of these data shall be demonstrated to the approval authority.

3. REESS voltage

3.1. External REESS voltage measurement

The REESS voltage(s) shall be measured during the tests. The voltage measurement equipment shall fulfil the requirements specified in paragraph 1.2. of this Annex. To measure the REESS voltage using external measuring equipment, the manufacturers shall support the approval authority by providing REESS voltage measurement points.

3.2. Vehicle on-board REESS voltage data

As an alternative to paragraph 3.1. of this Appendix, the manufacturer may use the on-board voltage measurement data. The accuracy of these data shall be demonstrated to the approval authority.”

Annex 9, title amend to read:

“Annex 9

Method of measuring the electric range of vehicles powered by an electric power train only or by a hybrid electric power train and the OVC range of vehicles powered by a hybrid electric powertrain”

Annex 9, Paragraph 1.; amend to read:

“1. Measurement of the electric range

The test method described hereafter permits to measure ~~the electric range, expressed in km, of vehicles powered by an electric power train only or the~~ electric range and OVC range of vehicles powered by a hybrid electric power train with off-vehicle charging (OVC-HEV as defined in paragraph 2. of Annex 8 to this Regulation).”

Annex 9, Paragraph 3.1.6.; amend to read:

“3.1.6. The vehicle must have undergone at least 300 km **or one full charge distances, whichever is longer** ~~during the seven days before the test~~ with those batteries that are installed in the test vehicle.”

Annex 9, Paragraph 4.1.1.1.; amend to read and delete Annex 9 subparagraphs 4.1.1.1.1. and 4.1.1.1.2.:

“4.1.1.1. **Reserved**

~~4.1.1.1. For pure electric vehicles:~~

~~4.1.1.1.1. The procedure starts with the discharge of the battery of the vehicle while driving (on the test track, on a chassis dynamometer, etc.) at a steady speed of 70 per cent +/- 5 per cent from the maximum thirty minutes speed of the vehicle.~~

~~4.1.1.1.2. Stopping the discharge occurs:~~

- ~~(a) When the vehicle is not able to run at 65 per cent of the maximum thirty minutes speed;~~
- ~~(b) Or when an indication to stop the vehicle is given to the driver by the standard onboard instrumentation; or~~
- ~~(c) After covering the distance of 100 km.”~~

Annex 9, Paragraph 4.1.2.; amend to read:

“4.1.2. Application of a normal overnight charge

~~For a pure electric vehicle, the battery shall be charged according to the normal overnight charge procedure, as defined in paragraph 2.4.1.2. of Annex 7 to this Regulation, for a period not exceeding twelve hours.~~

For an OVC HEV, the battery shall be charged according to the normal overnight charge procedure as described in paragraph 3.2.2.5. of Annex 8 to this Regulation.”

Annex 9, Paragraph 4.2.1.; amend to read and delete Annex 9 subparagraphs 4.2.1.1. to 4.2.1.5.:

“4.2.1. **Reserved**

~~4.2.1. For pure electric vehicle:~~

~~4.2.1.1. The test sequence as defined in paragraph 1.1. of Annex 7 to this Regulation is applied on a chassis dynamometer adjusted as described in Appendix 1 of Annex 7 to this Regulation, until the end of the test criteria is reached.~~

~~4.2.1.2. The end of the test criteria is reached when the vehicle is not able to meet the target curve up to 50 km/h, or when an indication from the standard on board instrumentation is given to the driver to stop the vehicle.~~

~~Then the vehicle shall be slowed down to 5 km/h by releasing the accelerator pedal, without touching the brake pedal and then stopped by braking.~~

~~4.2.1.3. At a speed over 50 km/h, when the vehicle does not reach the required acceleration or speed of the test cycle, the accelerator pedal shall remain fully depressed until the reference curve has been reached again.~~

~~4.2.1.4. To respect human needs, up to three interruptions are permitted between test sequences, of no more than fifteen minutes in total.~~

~~4.2.1.5. At the end, the measure D_e of the covered distance in km is the electric range of the electric vehicle. It shall be rounded to the nearest whole number.”~~

II. Justification

1. UN GTR No. 15 (WLTP) has introduced a shortened Type 1 test procedure as well as a new conformity of production test procedure for pure electric vehicles.
2. These two introductions have been made to reduce on the one hand the testing time of the vehicles in lab and on the other hand to install robust procedures for the determination of electric energy consumption and range
3. This Amendment introduces both, shortened type 1 test procedure and the new COP procedure, also in the context of UN Regulation No. 101.
4. The new COP procedure has been added to the main body of this Regulation as an alternative, the shortened type 1 test procedure has been added to Annex 7 of this Regulation and can be applied if a PEV has more range than the defined threshold in paragraph 1. of Annex 7.
5. Required changes in the structure of the regulation had been that the method of measuring the range of electric range of vehicles powered by an electric powertrain only (means pure electric vehicles) has been deleted from Annex 9 and moved to Annex 7.
4. This concept has been adopted in the UN Regulation No. 154 and it is proposed to also include it in the x series which may be used in some markets.
5. As the processes for determination of road load in Regulation No. 83 and for Pure Electric Vehicles in Regulation 101 have diverged over the years, it would reduce approval

burden to permit manufacturers to determine the road loads for PEVs according to the procedures for other vehicles described in Regulation No. 83.
