

29 September 2022

Agreement

Concerning the Adoption of Harmonized Technical United Nations Regulations for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these United Nations Regulations*

(Revision 3, including the amendments which entered into force on 14 September 2017)

Addendum 100 – UN Regulation No. 101

Revision 3 - Amendment 10

Supplement 11 to the 01 series of amendments – Date of entry into force: 22 June 2022

Uniform provisions concerning the approval of passenger cars powered by an internal combustion engine only, or powered by a hybrid electric power train with regard to the measurement of the emission of carbon dioxide and fuel consumption and/or the measurement of electric energy consumption and electric range, and of categories M₁ and N₁ vehicles powered by an electric power train only with regard to the measurement of electric energy consumption and electric range

This document is meant purely as documentation tool. The authentic and legal binding text is: ECE/TRANS/WP.29/2021/134.



UNITED NATIONS

* Former titles of the Agreement:

Agreement concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958 (original version); Agreement concerning the Adoption of Uniform Technical Prescriptions for Wheeled Vehicles, Equipment and Parts which can be Fitted and/or be Used on Wheeled Vehicles and the Conditions for Reciprocal Recognition of Approvals Granted on the Basis of these Prescriptions, done at Geneva on 5 October 1995 (Revision 2).



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 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 be confirmed by testing according to the procedure that is described in paragraph 9.4.3. below.

9.4.1.6. ..."

Insert a new paragraph 9.4.3., to read:

"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 to this Regulation (consecutive cycle procedure) and paragraph 5.2.3.2. to Annex 7 to 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 to this Regulation.

9.4.3.2. During these first two NEDC test cycles, the DC energy from the REESS(s) shall be measured according to the method described in Appendix 3 to Annex 7 to this Regulation and divided by the driven distance in these 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 CO_2 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

Title, amend to read.:

"Annex 7

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

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

Parameter	Units	Accuracy	Resolution
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."

Paragraphs 1., 1.1., 1.2. and 1.3., renumber as paragraphs 2., 2.1., 2.2. and 2.3. respectively and amend to read:

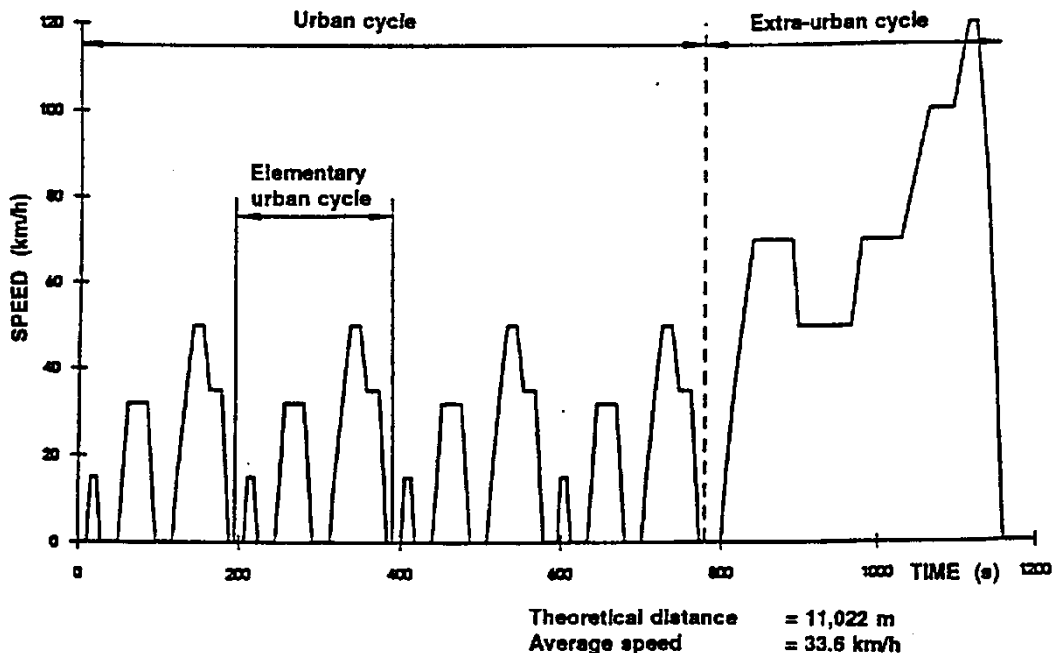
"2. NEDC test cycle

2.1. Composition

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

...

Figure 1
 NEDC test cycle



2.2. Urban cycle

...

2.3. Extra-urban cycle

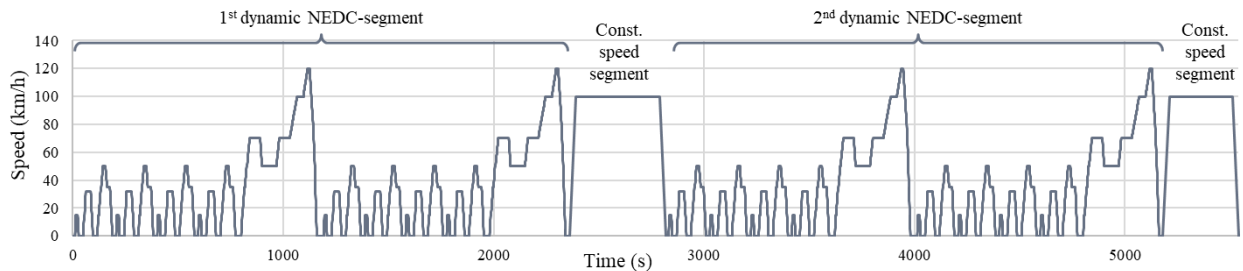
..."

Insert new paragraph 3., to read:

"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 5.2.3.2.1. 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_{CSSE} is the length of constant speed segment $CSSE$, km."

Paragraph 1.4., renumber to 4. and amend to read:

- "4. Tolerance
 - 4.1. Tolerances for driving the NEDC test cycle
- Tolerances are given in Figure 4.

Figure 4 ...

...

Over 50 km/h, it is accepted to go beyond tolerances provided the accelerator pedal is fully depressed.

- 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."

Paragraph 2. renumber as 5., to read:

- "5. Test method"

Paragraphs 2.1. and 2.2., delete

Paragraphs 2.3. to 2.3.1.6., renumber as 5.1. to 5.1.1.6. respectively

Paragraph 5.1., amend to read:

- "5.1. Vehicle
- 5.1.1. Condition of the vehicle
- 5.1.1.1. 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. The viscosity of the oils for the mechanical moving parts shall conform to the specification of the vehicle manufacturer.
- 5.1.1.3. 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. 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. 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. 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."

Paragraph 2.4., renumber as 5.2. and amend to read:

- "5.2. Operation mode
- All the tests are conducted at a temperature of between 20 °C and 30 °C.

The general test method includes the 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.

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."

Paragraph 2.4.1., delete

Paragraphs 2.4.1.1. to 2.4.1.2.2., renumber as 5.2.1. to 5.2.2.2. and amend to read:

"5.2.1. 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.

5.2.2. Application of a normal 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.

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

5.2.2.2. 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,

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

Paragraph 2.4.1.2.3., delete

Paragraph 2.4.2., renumber as 5.2.3. and amend to read:

"5.2.3. Application of the cycle test procedure to determine the pure electric range and the electric energy consumption

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

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 3 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

<i>Distance driven in constant speed segment CSS_M (km)</i>	<i>Maximum total break (min)</i>
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 3 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. to 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."

Paragraph 2.4.3. renumber as 5.2.4., delete paragraph 2.4.4. and insert new paragraph 5.2.5., to read:

"5.2.4. 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.

The vehicle shall be charged according to normal charge procedure in accordance with paragraph 5.2.2. 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.

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 3 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 3 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 3 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 be 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:

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

in case of at least three NEDC test cycles driven:

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

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 DS_1 and DS_2 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 DS_1 of the shortened test procedure, Wh;

$\Delta E_{REESS,DS_2}$ is the electric energy change of all REESSs during DS_2 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:

$E_{DC,j}$ 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

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

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."

Insert a new Annex 7, Appendix 3, to read:

"Annex 7 - Appendix 3

Determination of REESS current and REESS voltage of 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 a hybrid electric power train and the OVC range of vehicles powered by a hybrid electric powertrain"

Paragraph 1., amend to read:

- "1. Measurement of the electric range
- The test method described hereafter permits to measure 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)."

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 with those batteries that are installed in the test vehicle."

Paragraph 4.1.1.1., amend to read

- "4.1.1.1. (Reserved)"

Paragraphs 4.1.1.1.1. and 4.1.1.1.2., delete

Paragraph 4.1.2.; amend to read:

- "4.1.2. Application of a normal overnight charge
- 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."

Paragraph 4.2.1., amend to read:

- "4.2.1. (Reserved)"

Paragraphs 4.2.1.1. to 4.2.1.5., delete
