(…)

2. Definitions

(…)

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.

(…)

5. Specifications and tests

(…)

5.3. Description of tests for vehicles powered by an electric power train only

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.

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.

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.

(…)

9. Conformity of production

(…)

9.4. Vehicles powered by an electric power train only:

As a general rule, measures to ensure the conformity of production with regard to electric energy consumption is checked on the basis of the description in the type approval certificate set out in Annex 4 to this Regulation.

9.4.1. The holder of the approval shall, in particular:

9.4.1.1. Ensure the existence of procedures for the effective control of production quality;

9.4.1.2. Have access to the equipment necessary for checking conformity with each approved type;

Commented [OICA1]: Electric range for PEVs deleted from Annex 9 and added to Annex 7

Commented [OICA2]: Added to Annex 7

Commented [OICA3]: Deleted from Annex 9 and added to Annex 7.

Commented [OICA4]: Keep second sentence as numbering can be kept and second sentence also can stay standalone.

9.4.1.3. Ensure that the data concerning the test result are recorded and that the annexed documents are available during a period to be agreed with the Type Approval Authority;

9.4.1.4. Analyse the results of each type of test so as to monitor and ensure the consistency of the characteristics of the product, taking into account the variations admissible in industrial manufacture;

9.4.1.5. Make sure that for each type of vehicle ~~tests~~ the electric energy consumption testing prescribed in Annex 7 to this Regulation is~~are~~ carried out; notwithstanding the requirements of paragraph ~~2.3.~~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 and up to the manufacturer, the electric energy consumption may confirmed by testing according to the procedure that is described in paragraph 9.4.3. below.

Commented [OICA5]: Alternative added for EC confirmation during COP

9.4.1.6. Make sure that any collections of samples or test pieces demonstrating non-conformity with the type test under consideration is followed by a subsequent sampling and a further test. All necessary steps shall be taken to re-establish the conformity of production.

9.4.2. The competent authorities issuing the approval may verify at any time the methods applied in each production unit.

9.4.2.1. In every inspection, the records of tests and production monitoring shall be communicated to the visiting inspector.

9.4.2.2. The inspector may select at random the samples to be tested in the manufacturer's laboratory. The minimum number of samples may be determined on the basis of the results of the manufacturer's own checks.

9.4.2.3. When the quality standard does not seem satisfactory or when it seems necessary to verify the validity of the tests conducted under paragraph 9.4.2.2. above, the inspector shall collect samples to be sent to the Technical Service which carried out the approval tests.

9.4.2.4. The Type Approval Authorities may carry out all the tests prescribed in this Regulation.

9.4.3. Alternative for electric energy consumption verification for conformity of production

Commented [OICA6]: Alternative for EC COP.

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 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

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

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.

Procedures to determine pure electric range and electric energy consumption

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
Energy	Wh	±0.2 per cent	Class 0.2 s according to IEC 687

IEC = International Electrotechnical Commission

~~1~~2. NEDC ~~T~~test ~~sequence~~ cycle

~~1~~2.1. Composition

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

(a) An urban cycle made of four elementary urban cycles;

(b) An extra-urban cycle.

In case of a manual gear box with several gears, the operator changes the gear according to the manufacturer's specifications.

If the vehicle has several driving modes, which may be selected by the driver, the operator shall select the one to best match the target curve.

Figure 1
~~Text sequence~~NEDC test cycle

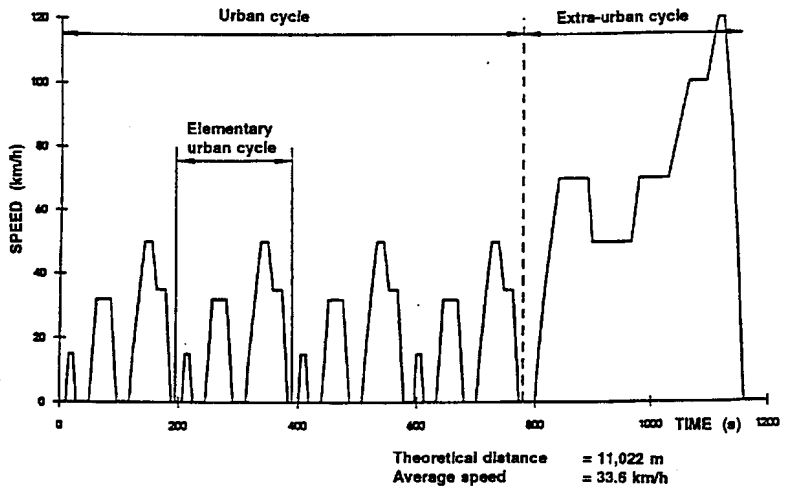


Figure 1
NEDC test cycle - M1 and N1 categories of vehicles

~~1~~2.2. Urban cycle

The urban cycle is composed of four elementary cycles of 195 seconds each and lasts 780 seconds in total.

Description of the elementary urban cycle is given in Figure 2 and Table 1.

Figure 2
Elementary urban cycle (195 seconds)

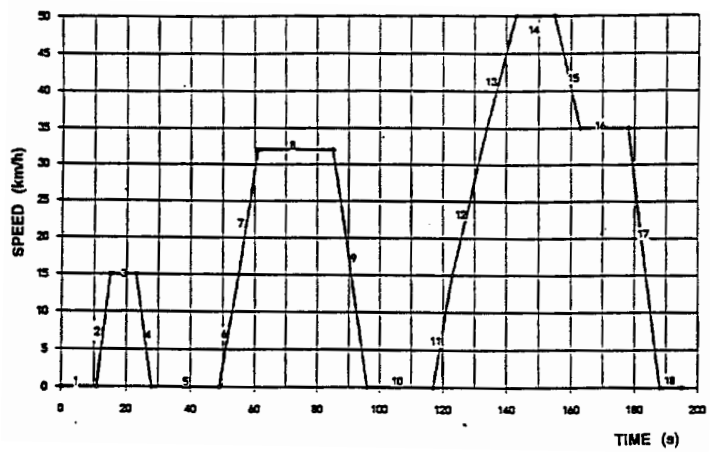


Table 1
Elementary urban cycle

Operation N°	*Operation type*	*Elementary urban cycle*			*Operation duration (s)*	*Mode duration (s)*	*Total time (s)*
		Mode N°	*Acceleration (m/s^2)*	*Speed (km/h)*			
1	Stop	1	0.00	0	11	11	11
2	Acceleration	2	1.04	0-15	4	4	15
3	Constant speed	3	0.00	15	8	8	23
4	Deceleration	4	-0.83	15-0	5	5	28
5	Stop	5	0.00	0	21	21	49
6	Acceleration	6	0.69	0-15	6	12	55
7	Acceleration		0.79	15-32	6		61
8	Constant speed	7	0.00	32	24	24	85
9	Deceleration	8	-0.81	32-0	11	11	96
10	Stop	9	0.00	0	21	21	117
11	Acceleration	10	0.69	0-15	6	26	123
12	Acceleration		0.51	15-35	11		134
13	Acceleration		0.46	35-50	9		143
14	Constant speed	11	0.00	50	12	12	155
15	Deceleration	12	-0.52	50-35	8	8	163
16	Constant speed	13	0.00	35	15	15	178
17	Deceleration	14	-0.97	35-0	10	10	188
18	Stop	15	0.00	0	7	7	195

Generalities	In time(s)	In percentage
Stop	60	30.77
Acceleration	42	21.54
Constant speed	59	30.26
Deceleration	34	17.44
Total	195	100.00

Average speed (km/h)	18.77

Working time (s)	195
Theoretical distance by elementary urban cycle (m)	1,017
Theoretical distance for four elementary urban cycles (m)	4,067

~~1~~2.3. Extra-urban cycle

The description of the extra-urban cycle is given in Figure 3 and Table 2.

Figure 3
Extra-urban cycle (400 seconds)

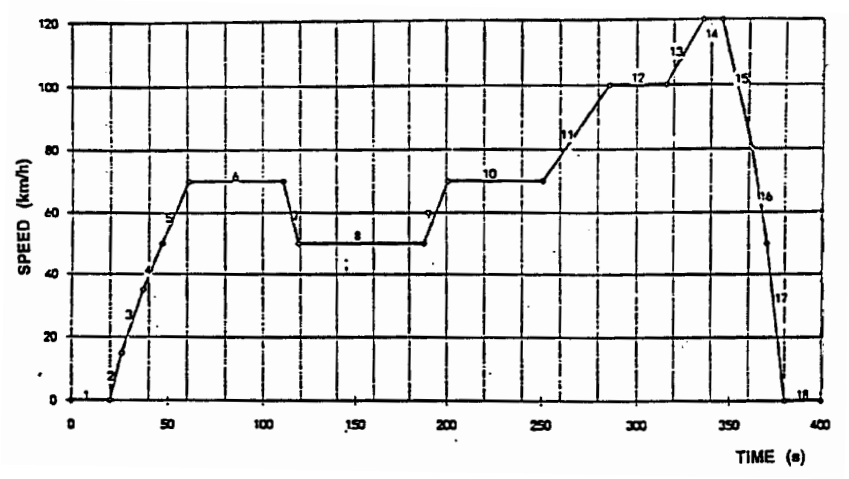


Table 2

Operation N°	*Operation type*	*Extra-urban cycle*			*Operation duration*	*Mode duration*	*Total time*
		Mode N°	*Acceleration (m/s^2)*	*Speed (km/h)*	*(s)*	*(s)*	*(s)*
1	Stop	1	0.00	0	20	20	20
2	Acceleration	2	0.69	0-15	6	41	26
3	Acceleration		0.51	15-35	11		37
4	Acceleration		0.42	35-50	10		47
5	Acceleration		0.40	50-70	14		61
6	Constant speed	3	0.00	70	50	50	111
7	Deceleration	4	-0.69	70-50	8	8	119
8	Constant speed	5	0.00	50	69	69	188
9	Acceleration	6	0.43	50-70	13	13	201
10	Constant speed	7	0.00	70	50	50	251
11	Acceleration	8	0.24	70-100	35	35	286
12	Constant speed	9	0.00	100	30	30	316
13	Acceleration	10	0.28	100-120	20	20	336
14	Constant speed	11	0.00	120	10	10	346
15	Deceleration	12	-0.69	120-80	16	34	362
16	Deceleration		-1.04	80-50	8		370
17	Deceleration		-1.39	50-0	10		380
18	Stop	13	0.00	0	20	20	400

Generalities	In time(s	In percentage
Stop	40	10.00
Acceleration	109	27.25
Constant speed	209	52.25
Deceleration	42	10.50
Total	400	100.00

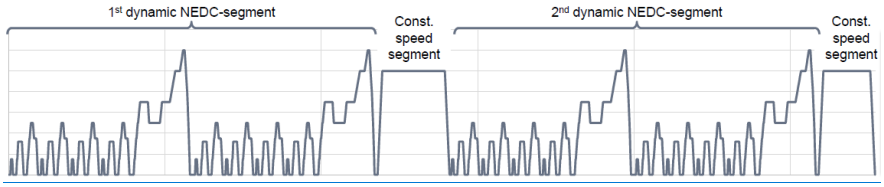
Average speed (km/h)	62.60
Working time (s)	400
Theoretical distance (m)	6,956

3. Shortened NEDC test sequence

The shortened NEDC test sequence consists of two dynamic NEDC-segments (DS_1 and DS_2) combined with two constant speed segments (CSS_M and CSS_E) as shown in the following figure.

Figure x

Shortened NEDC test sequence



The dynamic NEDC segments DS_1 and DS_2 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-cycles.

3.1. Dynamic NEDC segments

Each dynamic NEDC segment DS_1 and DS_2 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 DS_2 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.

Commented [OICA7]: Do we need an option for 80 km/h according to 3-phase WLTC?

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;

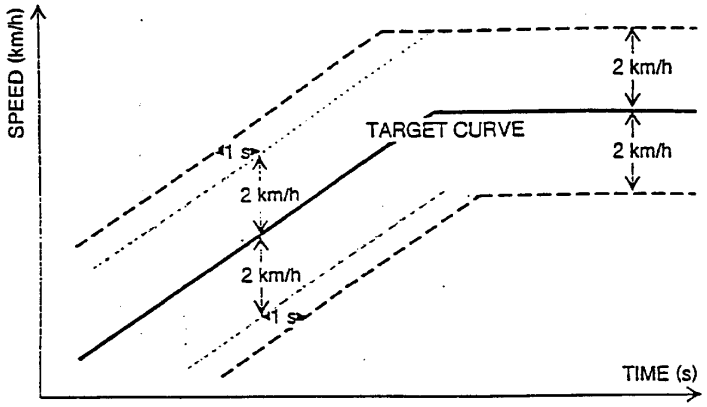
d_{CSSE} is the length of constant speed segment CSS_E, km.

4. Tolerance

4.1. Tolerances for driving the NEDC test cycle

Tolerances are given in Figure 4.

Figure 4
Speed tolerance



Tolerances on speed (±2 km/h) and on time (±1 s) are geometrically combined at each point as represented in Figure 4.

Below 50 km/h, deviations beyond this tolerance are permitted as follows:

(a) At gear changes for a duration less than 5 seconds,

(b) And up to five times per hour at other times, for a duration less than 5 seconds each.

The total time out of tolerance has to be mentioned in the test report.

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

Commented [OICA8]: Are 50 km/h still reasonable? → to be discussed

Commented [OICA9]: Are 50 km/h still reasonable? → to be discussed

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

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

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

~~2~~5. Test method

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, ~~during the seven days~~ before the test with those batteries that are installed in the test vehicle.

Commented [OICA10]: Align GTR#15 Amd#5 (and UNR154)
1. Strike out "within 7days before the test" requirement
2. Add "one full charge distance"

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 ~~four~~ following steps:

(a) Discharging the battery in accordance with paragraph 5.2.1. of this Annex;~~Initial charge of the battery;~~

(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~~twice of the cycle made of four elementary urban cycles and an extra urban cycle~~;

(d) Application of a normal ~~C~~charge~~ing the battery~~ in accordance with paragraph 5.2.2. of this Annex;

(e) ~~Calculation~~ 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.

~~2.4.1. Initial charge of the battery~~

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

5.2.1.~~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.~~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.~~1.2.~~ Application of a normal ~~overnight~~ charge

The battery shall be charged according to the following procedure.

5.2.2.1. ~~Normal overnight c~~Charginge procedure

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. 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,

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

~~.1.2.3. Fully charged battery~~

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

5.2.3. 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.

Commented [-11]: Amendment to bring it in line with WLTP.

Future cars with a possible 30 minutes max speed of 250kph would mean that you need to discharge at 175kph → maybe not feasible

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

~~Starting within 4 hours from t0, 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 Dtest of the covered distance in km is recorded.~~

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~~sequences~~, of no more than fifteen minutes in total.

[WLTP: 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 ~~end of the test criteria~~ 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.

Commented [OICA12]: Are 50 km/h still reasonable? → to be discussed

~~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.~~

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.

Commented [OICA13]: Are 50 km/h still reasonable? → to be discussed

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.

5.2.4. Charge of the battery

The vehicle shall be connected to the mains within the ~~30~~ 120 minutes after the ~~conclusion of the cycle made of four elementary urban cycles and an extra-urban cycle, carried out twice~~break-off criterion in accordance with paragraph 5.2.3.1.3. or 5.2.3.2.3. respectively.

Commented [OICA14]: Proposal to apply the 120 minutes from WLTP.

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 recharged electric energy E_{AC} 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.~~

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

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

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:

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

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:

$EC_{DC,j}$ 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 DS_1 of the shortened test procedure;

k_2 is the weighting factor of DS_2 of the shortened test procedure;

$\Delta E_{REESS,DS_1}$ is the electric energy change of all REESSs during DS_1 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.

~~.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:~~

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

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

Annex 7 - Appendix 1

Determination of the total road load power of a vehicle powered by an electric power train only, and calibration of the dynamometer

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.

2. Characteristics of the track

The test road layout shall be level, straight and free of obstacles or wind barriers which adversely affect the variability of road load measurement.

The test road longitudinal slope shall not exceed ±2 per cent. This slope is defined as the ratio of the difference in elevation between both ends of the test road and its overall length. In addition, the local inclination between any two points 3 m apart shall not deviate by more than ±0.5 per cent from this longitudinal slope.

The maximum cross-sectional camber of the test road shall be 1.5 per cent or less.

3. Atmospheric conditions

3.1. Wind

Testing shall be performed at wind speeds averaging less than 3 m/s with peak speeds less than 5 m/s. In addition, the vector component of the wind speed across the test track must be less than 2 m/s. Wind velocity shall be measured at 0.7 m above the track surface.

3.2. Humidity

The track shall be dry.

3.3. Reference conditions

Barometric pressure $H_0 = 100$ kPa

Temperature $T_0 = 293$ K (20 °C)

Air density $d_0 = 1.189$ kg/m^3

3.3.1. Air density

3.3.1.1. The air density during the test, calculated as described in paragraph 3.3.1.2. below, shall not differ by more than 7.5 per cent from the air density under the reference conditions.

3.3.1.2. The air density shall be calculated by the formula:

$$d_T = d_0 \cdot \frac{H_T}{H_0} \cdot \frac{T_0}{T_T}$$

Where:

d_T is the air density during the test (kg/m^3)

d_0 is the air density at reference conditions (kg/m^3)

H_T is the total barometric pressure during the test (kPa)

T_T is absolute temperature during the test (K).

3.3.2. Ambient conditions

3.3.2.1. The ambient temperature shall be between 5 °C (278 K) and 35 °C (308 K) and the barometric pressure between 91 kPa and 104 kPa. The relative humidity shall be less than 95 per cent.

3.3.2.2. However, with the manufacturer's agreement, the tests may be made at lower ambient temperatures down to 1 °C. In this case the correction factor calculated for 5 °C should be used.

4. Preparation of the vehicle

4.1. Running-in

The vehicle shall be in normal running order and adjustment after having been run in for at least 300 km. The tyres shall be run in at the same time as the vehicle or shall have a tread depth within 90 and 50 per cent of the initial tread depth.

4.2. Checks

The following checks shall be made in accordance with the manufacturer's specifications for the use considered: wheels, wheel rims, tyres (make, type, pressure), front axle geometry, brake adjustment (elimination of parasitic drag), lubrication of front and rear axles, adjustment of the suspension and vehicle ground clearance, etc. Check that during freewheeling, there is no electrical braking.

4.3. Preparation for the test

4.3.1. The vehicle shall be loaded to its test mass including driver and measurement equipments, spread in a uniform way in the loading areas.

4.3.2. The windows of the vehicle shall be closed. Any covers for air conditioning systems, headlamps, etc. shall be closed.

4.3.3. The vehicle shall be clean.

4.3.4. Immediately before the test, the vehicle shall be brought to the normal running temperature in an appropriate manner.

5. Specified speed V

The specified speed is required for determining the running resistance at the reference speed from the running resistance curve. To determine the running resistance as a function of vehicle speed in the vicinity of the reference speed V_o, running resistances shall be measured at the specified speed V. At least four to five points indicating the specified speeds, along with the reference speeds, are desired to be measured.

Table 1 shows the specified speeds in accordance with the category of the vehicle. The asterisk * indicates the reference speed in the table.

Table 1

Category V max.	*Specified speeds (km/h)*					
> 130	120**	100	80*	60	40	20
130 – 100	90	80*	60	40	20	-
100 – 70	60	50*	40	30	20	-
< 70	50**	40*	30	20	-	-
* Reference speed ** If it could be reached by the vehicle.						

6. Energy variation during coast-down

6.1. Total road load power determination

6.1.1. Measurement equipment and accuracy

The margin of measurement error shall be less than 0.1 second for time and less than ±0.5 km/h for speed.

6.1.2. Test procedure

6.1.2.1. Accelerate the vehicle to a speed of 5 km/h greater than the speed at which test measurement begins.

6.1.2.2. Put the gearbox to neutral, or disconnect the power supply.

6.1.2.3. Measure the time t_1 taken by the vehicle to decelerate from:

V2 = V + Δ Vkm/h to V1 = V - Δ Vkm/h

Where:

Δ V < 5 km/h for nominal speed < 50 km/h

Δ V < 10 km/h for nominal speed > 50 km/h

6.1.2.4. Carry out the same test in the opposite direction, measuring time t_2.

6.1.2.5. Take the average T1 of the two times t_1 and t_2.

6.1.2.6. Repeat these tests until the statistical accuracy (p) of the average

$$T = \frac{1}{n}\sum_{i=1}^{n} Ti$$

is equal to or less than 4 per cent (p < 4 per cent).

The statistical accuracy (p) is defined by:

$$p = \frac{t.s}{\sqrt{n}} \cdot \frac{100}{T}$$

Where:

T is the coefficient given by the table below

s is the standard deviation: $s = \sqrt{\sum_{i=1}^{n} \frac{(Ti - T)^2}{n - 1}}$

n is the number of tests

n	*4*	*5*	*6*	*7*	*8*	*9*	*10*
t	3.2	2.8	2.6	2.5	2.4	2.3	2.3
t/√n	1.6.	1.25	1.06	0.94	0.85	0.77	0.73

6.1.2.7. Calculation of the running resistance force

The running resistance force F at the specified speed V is calculated as follows:

$$F = (M_{HP} + M_r) \cdot \frac{2\Delta V}{\Delta T} \cdot \frac{1}{3.6} \quad [N]$$

Where:

M_{HP} is the test mass

M_r is the equivalent inertia mass of all the wheels and vehicle portions rotating with the wheels during coast down on the road. M_r should be measured or calculated by an appropriate manner.

6.1.2.8. The running resistance determined on the track shall be corrected to the reference ambient conditions as follows:

F corrected = k · F measured

$$k = \frac{R_R}{R_T}\left[1 + K_R (t - t_0)\right] + \frac{R_{AERO}}{R_T}\frac{d_0}{d_t}$$

Where:

R_R is the rolling resistance at speed V

R_{AERO} is the aerodynamic drag at speed V

R_T is the total road load = R_R+R_{AERO}

K_R is the temperature correction factor of rolling resistance, taken to be equal to: 3.6×10^{-3}/°C

t is the road test ambient temperature in °C

t_0 is the reference ambient temperature = 20 °C

d_t is the air density at the test conditions

d_0 is the air density at the reference conditions

(20 °C, 100 kPa) = 1.189 kg/m3.

The ratios R_R/R_T and R_{AERO}/R_T shall be specified by the vehicle manufacturer on the basis of the data normally available to the company.

If these values are not available, subject to the agreement of the manufacturer and the Technical Service concerned, the figures for the rolling/total resistance ratio given by the following formula may be used:

$$\frac{R_R}{R_T} = aM_{HP} + b$$

Where:

M_{HP} is the test mass

and for each speed the coefficients a and b are as shown in the following table:

V (km/h)	*a*	*b*
20	$7.24 \cdot 10^{-5}$	0.82
40	$1.59 \cdot 10^{-4}$	0.54
60	$1.96 \cdot 10^{-4}$	0.33
80	$1.85 \cdot 10^{-4}$	0.23
100	$1.63 \cdot 10^{-4}$	0.18
120	$1.57 \cdot 10^{-4}$	0.14

6.2. Setting of the dynamometer

The purpose of this procedure is to simulate on the dynamometer the total road load power at a given speed.

6.2.1. Measurement equipment and accuracy

The measuring equipment shall be similar to that used on the track.

6.2.2. Test procedure

6.2.2.1. Install the vehicle on the dynamometer.

6.2.2.2. Adjust the tyre pressure (cold) of the driving wheels as required for the chassis dynamometer.

6.2.2.3. Adjust the equivalent inertia mass of the chassis dynamometer, according to Table 2.

Table 2

Test mass M_{HP} *(kg)*	*Equivalent inertia I (kg)*
$M_{HP} \leq 480$	455
$480 < M_{HP} \leq 540$	510
$540 < M_{HP} \leq 595$	570
$595 < M_{HP} \leq 650$	625
$650 < M_{HP} \leq 710$	680
$710 < M_{HP} \leq 765$	740
$765 < M_{HP} \leq 850$	800
$850 < M_{HP} \leq 965$	910
$965 < M_{HP} \leq 1,080$	1,020
$1,080 < M_{HP} \leq 1,190$	1,130
$1,190 < M_{HP} \leq 1,305$	1,250
$1,305 < M_{HP} \leq 1,420$	1,360
$1,420 < M_{HP} \leq 1,530$	1,470
$1,530 < M_{HP} \leq 1,640$	1,590
$1,640 < M_{HP} \leq 1,760$	1,700
$1,760 < M_{HP} \leq 1,870$	1,810

Test mass M_{HP} *(kg)*	*Equivalent inertia* *I* *(kg)*
$1,870 < M_{HP} \leq 1,980$	1,930
$1,980 < M_{HP} \leq 2,100$	2,040
$2,100 < M_{HP} \leq 2,210$	2,150
$2,210 < M_{HP} \leq 2,380$	2,270
$2,380 < M_{HP} \leq 2,610$	2,270
$2,610 < M_{HP}$	2,270

6.2.2.4. Bring the vehicle and the chassis dynamometer to the stabilized operating temperature, in order to approximate the road conditions.

6.2.2.5. Carry out the operations specified in paragraph 6.1.2. of this annex with the exception of paragraphs 6.1.2.4. and 6.1.2.5., replacing M_{HP} by I and M_r by M_{rm} in the formula given in paragraph 6.1.2.7.

6.2.2.6. Adjust the brake to reproduce the corrected running resistance half payload (paragraph 6.1.2.8. of this annex) and to take into account the difference between the vehicle mass on the track and the equivalent inertia test mass (I) to be used. This may be done by calculating the mean corrected road coast down time from V_2 to V_1 and reproducing the same time on the dynamometer by the following relationship:

$$T_{corrected} = (I + M_{rm}) \frac{2\Delta V}{F_{corrected}} \cdot \frac{1}{3.6}$$

Where:

I is the flywheel equivalent inertia mass of chassis dynamometer.

M_{rm} is the equivalent inertia mass of the powered wheels and vehicle portions rotating with the wheels during coast down. M_{rm} shall be measured or calculated by an appropriate manner.

6.2.2.7. The power P_a to be absorbed by the bench should be determined in order to enable the same total road load power to be reproduced for the same vehicle on different days or on different chassis dynamometers of the same type.

Annex 7 - Appendix 2

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.

1.4. 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

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

Commented [OICA15]: Deletion of PEV contents from Annex 9 → shifted to Annex 7

1. Measurement of the electric range

The test method described hereafter permits to measure the ~~electric~~ OVC 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).

2. Parameters, units and accuracy of measurements

Parameters, units and accuracy of measurements shall be as follows:

Parameter	*Unit*	*Accuracy*	*Resolution*
Time	s	+/-0.1 s	0.1 s
Distance	m	+/-0.1 per cent	1 m
Temperature degrees	C	+/-1 degree C	1 degree C
Speed	km/h	+/-1 per cent	0.2 km/h
Mass	kg	+/-0.5 per cent	1 kg
Electricity balance	Ah	+/-0.5 per cent	0.3 per cent

3. Test conditions

3.1. Condition of the vehicle

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.

3.1.2. The viscosity of the oils for the mechanical moving parts shall conform to the specifications of the vehicle manufacturer.

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

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.

3.1.5. If the batteries are operated above the ambient temperature, the operator shall follow the procedure recommended by the vehicle 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.

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

3.2. Climatic conditions

For testing performed outdoors, the ambient temperature shall be between 5 °C and 32 °C.

The indoors testing shall be performed at a temperature between 20 °C and 30 °C.

4. Operation modes

The test method includes the following steps:

(a) Initial charge of the battery;

(b) Application of the cycle and measurement of the electric range.

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

4.1. Initial charge of the battery

Charging the battery consists of the following procedures:

Note: "Initial charge of the battery" applies to the first charge of the battery, at the reception of the vehicle. In case of several combined tests or measurements, carried out consecutively, the first charge carried out shall be an "initial charge of the battery" and the following may be done in accordance with the "normal overnight charge" procedure.

4.1.1. Discharge of the battery

4.1.1.1. ReservedFor 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.

4.1.1.2. For externally chargeable Hybrid Electric Vehicle (OVC HEV) without an operating mode switch as defined in Annex 8 to this Regulation:

4.1.1.2.1. The manufacturer shall provide the means for performing the measurement with the vehicle running in pure electric operating state.

4.1.1.2.2. 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 at 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 manufacturers' recommendation.

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

4.1.1.3. For externally chargeable Hybrid Electric Vehicle (OVC HEV) with an operating mode switch as defined in Annex 8 to this Regulation:

4.1.1.3.1. If there is not a pure electric position, the manufacturer shall provide the means for performing the discharge of the battery with the vehicle running in pure electric operating state.

4.1.1.3.2. 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 +/-5 per cent of the maximum thirty minutes speed of the vehicle.

4.1.1.3.3. 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 onboard instrumentation; or

(c) After covering the distance of 100 km.

4.1.1.3.4. If the vehicle is not equipped with a pure electric operating state, 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 just does not start up for a defined time/distance (to be specified between Technical Service and manufacturer); or

(c) With manufacturers' recommendation.

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

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.

4.2. Application of the cycle and measurement of the range

4.2.1. Reserved~~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 De of the covered distance in km is the electric range of the electric vehicle. It shall be rounded to the nearest whole number.~~

4.2.2. For hybrid electric vehicles

4.2.2.1. To determine the electric range of a hybrid electric vehicle

4.2.2.1.1. The applicable test sequence and accompanying gear shift prescription, as defined in paragraph 1.4. of Annex 8, is applied on a chassis dynamometer adjusted as described in Appendices 2, 3 and 4 of Annex 4 to Regulation No. 83, until the end of the test criteria is reached.

To determine the electric range (De) of OVC HEVs equipped with an operating mode switch the same operating mode position, in accordance with Table 4.1.3 and paragraph 4.2.1 of Annex 8 to this Regulation, shall be used as for the determination of CO_2 and fuel consumption.

4.2.2.1.2. To measure the electric range 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 or when the battery has reached its minimum state of charge. 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.

4.2.2.1.3. 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. The maximum possible speed in pure electric operating state in the first combined cycle shall be recorded in the test report and in the drivers' handbook of production vehicles.

During this procedure, the electricity balance (QES_i) of the high voltage battery (expressed in Ampere hours), measured continuously and using the procedure specified in Appendix 2 to the Annex 8 to this Regulation, the vehicle speed (VES_i) and De_i shall be recorded at the instant when the fuel consuming engine starts and the accumulation of De_i shall be stopped. Further accumulation of De_i shall not be permitted unless:

(a) The fuel consuming engine stopped running; and

(b) VES_i has returned to the same or any lower level of VES_i as recorded before the fuel consuming engine started; and

(c) QES_i has returned to the same or any lower level of QES_i as recorded before the last fuel consuming engine start or, where applicable, to the same or any lower level of QSA_i as determined in accordance with paragraph 4.2.2.1.3.1. of this annex.

This procedure shall be followed until the end of the test as defined in paragraph 4.2.2.1.2. of this annex.

4.2.2.1.3.1. During the first deceleration phase following each start of the fuel consuming engine, when the vehicle speed is less than the vehicle speed at which the fuel consuming engine started previously:

(a) The distance covered with engine off should be counted as De_i; and

(b) The increase in electricity balance during this period should be recorded (ΔQrb_i); and

(c) The electricity balance when the fuel consuming engine starts (QES_i) defined previously should be corrected by ΔQrb_i (hence new $QSA_i = QES_i + \Delta Qrb_i$);

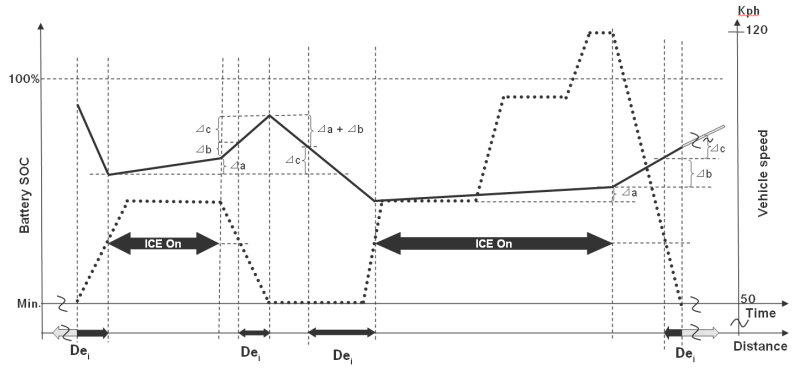
VES_i = Vehicle speed at the moment when the ICE starts;

QES_i = Energy of the battery at the moment when the ICE starts;

ΔQrb_i = The increase in electricity balance during deceleration phases, when the vehicle speed is less than the vehicle speed at which the ICE started previously;

QSA_i = Energy of the battery at the moment of the further accumulation of De.

Example:



⊿a = Charged by ICE

⊿b = Charged by regeneration (vehicle acceleration by ICE)

⊿c = Charged by regeneration (ΔQrb_i, vehicle acceleration with energy from battery)

$De = \Sigma De_i$

De_i = Distances where the propulsive energy was not produced by ICE

———— Battery SOC

..... Vehicle Speed

4.2.2.1.4. To respect human needs, up to three interruptions are permitted between test sequences, of no more than 15 minutes in total.

4.2.2.1.5. At the end, the electric range is the sum of all cycle portions De_i in km. It shall be rounded to the nearest whole number.

4.2.2.2. To determine the OVC range of a hybrid electric vehicle

4.2.2.2.1. The applicable test sequence and accompanying gear shift prescription, as defined in paragraph 1.4. of Annex 8, is applied on a chassis dynamometer adjusted as described in Appendices 2, 3 and 4 to Annex 4 to Regulation No. 83, until the end of the test criteria is reached.

4.2.2.2.2. To measure the OVC range the end of the test criteria is reached when the battery has reached its minimum state of charge according to the criteria defined in Annex 8 to this Regulation, paragraph 3.2.3.2.2. or 4.2.4.2.2. Driving is continued until the final idling period in the extra-urban cycle.

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

4.2.2.2.4. At the end, the total distance driven in km, rounded to the nearest whole number, is the OVC range of the hybrid electric vehicle.