Economic and Social Council

Distr.: General
~~XX~~ 26 March 2025

Original: English

Work in progress. Wording needs to be revised

Economic Commission for Europe

Inland Transport Committee

World Forum for Harmonization of Vehicle Regulations

Working Party on pollution and Energy

Ninety ~~First~~ Second session
Geneva, ~~xx~~25 ~~xx~~ 28 ~~xxxx~~ March 2025
Item X of the provisional agenda
UN Regulations Nos. xxxxxxx

Proposal for a new Regulation No. xx on the in-vehicle Battery Durability for Electrified Light-Duty Vehicles

Submitted by the United Kingdom of Great Britain and Northern Ireland

The text reproduced below was prepared by the experts from the United Kingdom of Great Britain and Northern Ireland ~~International Organization of Motor Vehicle Manufacturers~~ and is intended to transpose the content of Global Technical Regulation 22 into a Regulation of the 1958 Agreement.

Regulation No. xx

on the in-vehicle Battery Durability for Electrified Light-Duty Vehicles

Contents

		Page
1.	Scope and application	X
2.	Abbreviations	X
3.	Definitions	X
4.	Application for approval	X
5.	Approval	X
6.	Markings	X
7.	Requirements	X
8.	In-use verification	X
9.	Rounding	X
10.	Modification and extension of the type approval	X
11.	Conformity of production	X
12.	Penalties for non-conformity of production	X
13.	Production definitively discontinued	X
14.	Names and addresses of the Technical Services responsible for conducting approval tests and of Type Approval Authorities	X

Annexes

1	Vehicle and battery characteristics and information concerning the conduct of tests (‘information document’)	X
	Appendix 1 - Vehicle and battery characteristics and information concerning the conduct of tests	X
	Appendix 2 – Test Report	X
2	Communication	X
3	Arrangements of the approval mark	X
4	Vehicle survey	X
5	Values to be read from vehicles	X
6	Determination of Performance Parameter during Part A Test Procedure	X

1. Scope and application

1.1. This Regulation applies to vehicles of categories M_1 and N_1 that (a) are PEV or OVC-HEV vehicles, and (b) have an originally installed battery as defined in this Regulation.

While manufacturers commonly estimate or publicise other range-based metrics for informational purposes (such as, for example, an in-use range under real driving conditions, or the remaining range available before the next charging event), the range-related provisions of this Regulation are concerned only with the certified range as would be measured by the applicable certification test procedure.

2. Abbreviations

[BMS	Battery Management System]
DPR	Declared Performance Requirement
MPR	Minimum Performance Requirement
OTA	Over the Air
REESS	Rechargeable Electrical Energy Storage System
SOC	State of Charge
SOCE	State of Certified Energy
SOCR	State of Certified Range
UBE	Usable Battery Energy
UN-R154	UN Regulation No. 154
V2G	Vehicle to Grid
V2H	Vehicle to Home
V2L	Vehicle to Load

3. Definitions

For the purposes of this Regulation,

3.0. "Vehicle type" means vehicles which do not differ in the following parameters: (reserved)

3.1. "Battery" means, a rechargeable electrical energy storage system (REESS) installed in an electrified vehicle and used mainly for traction purposes.

3.2. "Originally installed battery" means the battery that is installed in the vehicle at the time of manufacture, or if the vehicle is manufactured without an installed battery, the battery that is installed in the vehicle when it is first operated on the road.

3.3. "Usable Battery energy (UBE)" means the energy supplied by the battery from the beginning of the test procedure used for certification until the applicable break-off criterion of the test procedure used for certification is reached.

3.4. "Certified usable battery energy" ($UBE_{certified}$) refers to the UBE that was determined during the certification of the vehicle, according to Annex 5 of this Regulation.

3.5. "Measured usable battery energy" ($UBE_{measured}$) means the UBE determined at the present point in the lifetime of the vehicle by the test procedure used for certification, according to Annex 5 of this Regulation.

3.6. "Electric Range" refers to the range that would be determined by the range test procedure used for certification of the vehicle, if the test was performed at the present point in the lifetime of the vehicle and with the originally installed battery.

3.7. "Certified range" ($Range_{certified}$) refers to the electric driving range that was determined during certification of the vehicle, according to Annex 5 of this Regulation.

3.8. "Measured range" ($Range_{measured}$) means the electric range determined at the present point in the lifetime of the vehicle by the test procedure used for certification, according to Annex 5 of this Regulation.

3.9. "State of certified energy" (SOCE) means the measured or on-board UBE performance at a specific point in its lifetime, expressed as a percentage of the certified usable battery energy.

3.10. "State of certified range" (SOCR) means the measured or on-board electric range at a specific point in its lifetime, expressed as a percentage of the certified range.

3.11. "Minimum Performance Requirement" (MPR) means the minimum durability performance, in terms of SOCE or SOCR at a specific point in the life of the vehicle, that constitutes compliance with the durability provisions of this Regulation.

3.12. "Declared Performance Requirement" (DPR) means an SOCE or SOCR value declared by the manufacturer that is greater than that of the corresponding MPR and which then becomes the minimum durability performance that constitutes compliance of that manufacturer with the durability provisions of this Regulation.

3.13. "SOCR monitor" means an apparatus installed in the vehicle that maintains an estimate of the state of certified range by means of an algorithm operating on data collected from the vehicle systems.

3.14. "SOCE monitor" means an apparatus installed in the vehicle that maintains an estimate of the state of certified energy by means of an algorithm operating on data collected from the vehicle systems.

3.15. "On-board SOCR" ($SOCR_{read}$) means an estimate of state of certified range produced by an SOCR monitor.

3.16. "On-board SOCE" ($SOCE_{read}$) means an estimate of state of certified energy produced by an SOCE monitor.

3.17. "Measured SOCR" ($SOCR_{measured}$) means the state of certified range as determined by the measured range divided by the certified range, according to paragraph 6.3.2. of this Regulation.

3.18. "Measured SOCE" means the state of certified energy as determined by the measured usable battery energy divided by the certified usable battery energy.

3.19. "V2X" means the use of the traction batteries to cover external power and energy demand, such as V2G (Vehicle-to-Grid) for grid stabilization by utilising traction batteries, V2H (Vehicle-to-Home) for utilizing traction

batteries as residential storage for local optimisation or emergency power sources in times of power failure, and V2L (Vehicle-to-Load, only connected loads are supplied) for use in times of power failure and/or outdoor activity in normal times.

3.20. "Total discharge energy during V2X" means the total amount of discharged energy during V2X which needs to be provided according to Annex 4 of this Regulation.

3.21. “Hybrid vehicle” (HV) means a vehicle equipped with a powertrain containing at least two different categories of propulsion energy converters and at least two different categories of propulsion energy storage systems.

3.21.1. "Hybrid electric vehicle" (HEV) means a hybrid vehicle where one of the propulsion energy converters is an electric machine.

3.21.2. "Off-vehicle charging hybrid electric vehicle" (OVC-HEV) means a hybrid electric vehicle that can be charged from an external source.

3.22. "Pure electric vehicle" (PEV) means a vehicle equipped with a powertrain containing exclusively electric machines as propulsion energy converters and exclusively rechargeable electric energy storage systems as propulsion energy storage systems.

3.23. "Maximum charging power" means the highest available charging power for the considered Part B family.

3.24. “Energy throughput” means the total amount of energy in kWh discharged from the battery.

3.25. “Total discharge energy for non-traction purposes” means the total amount of energy in kWh discharged from the battery for purposes other than traction to support the particular use case of a Category N vehicle and do not include air conditioning/heating for the cabin or other uses already present in category M.

3.26. "Odometer" means an instrument which indicates to the driver the total distance recorded by the vehicle since its production.

4. Application for approval

4.1. The application for approval of a vehicle type with regard to the requirements of this Regulation shall be submitted by the vehicle manufacturer or by their authorized representative, who is any natural or legal person who is duly appointed by the manufacturer to represent him before the approval authority and to act on his behalf in matters covered by this Regulation.

4.1.1. The application referred to in paragraph 4.1. shall be drawn up in accordance with the model of the information document set out in Annex 1 to this Regulation.

4.2. ~~An appropriate number of vehicles representative of the vehicle type to be approved shall be submitted to the Technical Service responsible for the approval tests.~~

~~4.3.~~ Changes to the make of a system, component or separate technical unit that occur after a ~~type approval~~type-approval shall not automatically invalidate a ~~type approval~~type-approval, unless its original characteristics or technical

parameters are changed in such a way that the ~~system power~~battery durability of the vehicle is adversely affected.

5. Approval

5.1. If the vehicle type submitted for approval meets all the relevant requirements of this Regulation, approval of that vehicle type shall be granted.

Manufacturers shall ensure that at type approval and during the in-service verification test, the requirements of paragraph 7 are met. For that purpose, the manufacturer is obliged to provide to the authorities a ~~certificated~~declaration of ~~compliance~~ conformity which declares that the vehicle type was designed and developed to compli~~es~~y with the requirements as stated in paragraph 7. In addition, the responsible authority may request additional data available during the development process at type approval, which ~~confirms~~supports the conformity declaration. ~~Further, the manufacturer shall perform the in-service conformity tests as described in paragraph 7. Responsible authorities and otherthird parties bodies may perform in-service verification tests.~~

Commented [JPN1]: Wording from UNR83

5.1.1. ~~Certificate~~Declaration of ~~compliance~~conformity (reserved)

5.2. An approval number shall be assigned to each type approved.

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

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

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

(a) Two digits (with leading zeros as applicable) indicating the series of amendments incorporating the technical provisions of the UN Regulation applied to the approval (00 for the UN Regulation in its original form);

(b) A slash (/) and two digits (with leading zeros as applicable) indicating the number of supplements to the series of amendments applied to the approval (00 for the series of amendments in its original form);

Section 3: A four-digit sequential number (with leading zeros as applicable). The sequence shall start from 0001.

Section 4: A two-digit sequential number (with leading zeros if applicable) to denote the extension. The sequence shall start from 00.

All digits shall be Arabic digits.

5.2.2. Example of an Approval Number to this Regulation:

E11*[XXX]R01/0~~0~~1*0123*01

The first extension of the Approval numbered 0123, issued by the United Kingdom to Supplement 1 to Series of Amendments 01.

5.2.3. The same Contracting Party shall not assign the same number to another vehicle type.

5.3. Notice of approval or of extension or refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Contracting Parties to the 1958 Agreement which apply this Regulation by means of a form conforming to the model in Annex 1 to this Regulation.

6. Markings

6.1. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark consisting of:

6.1.1. A circle surrounding the letter "E" followed by the distinguishing number of the country that has granted approval[1].

6.1.2. The number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle described in paragraph ~~5.4.1~~6.1.1.

6.2. If the vehicle conforms to a vehicle type approved, under one or more other Regulations annexed to the 1958 Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph ~~5.4.1.~~6.1.1. need not be repeated; in such a case, the Regulation, approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph ~~5.4.1~~6.1.1.

6.3. The approval mark shall be clearly legible and be indelible.

6.4. The approval mark shall be placed close to or on the vehicle data plate.

6.4.1. Annex 2 to this Regulation gives examples of arrangements of the approval mark.

X. Families within a vehicle type

X.1. Family identifiers

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

FT-nnnnnnnnnnnnnn-WMI

Where:

FT is an identifier of the family type:

(a) MF = Monitor family as defined in paragraph 8.1.1.

(b) BD = Battery Durability family as defined in paragraph 8.1.2.

(c) VD = virtual distance family (Tbd.)

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

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

[1] The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.6 – Annex 3, https://unece.org/transport/standards/transport/vehicle-regulations-wp29/resolutions.

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

X.2. ~~8.1.~~ Definitions of Families

Vehicles having the same characteristics with respect to their evaluation under Part A or Part B below shall be grouped into vehicle families for the purpose of compliance verification. Families under Part A shall have the same characteristics with respect to verification of the SOCR/SOCE monitors. Families under Part B shall have the same characteristics with respect to verification of battery durability.

Families with the same characteristics with respect to compliance verification shall be defined as follows:

~~8.1.1.~~X.2.1. For Part A: Verification of Monitors

Only vehicles that are substantially similar with respect to the following elements may be part of the same monitor family:

(a) Algorithm for estimating on-board SOCR and on-board SOCE;

(b) Sensor configuration (for sensors used in determination of SOCR and SOCE estimates);

(c) Characteristics of battery cell which have a non-negligible influence on accuracy of monitor;

(d) Type of vehicle (PEVs or OVC-HEVs).

At the request of the manufacturer, with the approval of the responsible authority and with appropriate technical justification, the manufacturer may deviate from the above criteria for families.

~~8.1.2.~~X.2.2. For Part B: Verification of Battery Durability

Only vehicles that are substantially similar with respect to the following elements may be part of the same battery durability family:

(a) Type and number of electric machines, including net power, construction type (asynchronous/ synchronous, etc.), and any other characteristics having a non-negligible influence on battery durability;

(b) Type of battery (dimensions, type of cell, including format and chemistry, capacity (Ampere-hour), nominal voltage, nominal power;

(c) Battery management system (BMS) (with regards to battery durability monitoring and estimations);

(d) Passive and active thermal management of the battery;

(e) Type of electric energy converter between the electric machine and battery, between the recharge-plug-in and battery, and any other characteristics having a non-negligible influence on battery durability;

(f) Operation strategy of all components influencing the battery durability;

(g) Declared maximum charging power.

At the request of the manufacturer, with the approval of the responsible authority and with appropriate technical justification, the manufacturer may deviate from the above criteria for families.

X.2.3. For Part C: Verification of reported virtual distance

Only vehicles that are substantially similar with respect to the following elements may be part of the same monitor family:

(a) Algorithm for reported virtual distance;

(b) Sensor configuration (for sensors used in determination of virtual distance);

(c) Characteristics of battery cell which have a non-negligible influence on accuracy of monitor;

(d) Type of vehicle (PEVs or OVC-HEVs).

At the request of the manufacturer, with the approval of the responsible authority and with appropriate technical justification, the manufacturer may deviate from the above criteria for families.]

7. Requirements

7.1. State-of-Certified Range and State-of Certified Energy (SOCR and SOCE) monitors

The manufacturer shall install SOCR and SOCE monitors that operate during the life of the vehicle. The SOCR monitor shall maintain an estimate of the state of certified range (on-board SOCR), and the SOCE monitor shall maintain an estimate of the state of certified energy (on-board SOCE).

The manufacturer shall determine the algorithms by which on-board SOCR and on-board SOCE are determined for the vehicles they produce. The manufacturer shall update the on-board SOCR and SOCE with sufficient frequency as to maintain the necessary degree of accuracy during all normal vehicle operation.

The on-board SOCR and SOCE shall have at least a resolution of 1 part in 100 and be used for the purposes of verification as the nearest whole number from 0 to 100.

The manufacturer shall make available the most recently determined values of the on-board SOCR and on-board SOCE via the OBD port and optionally over-the-air (OTA).

For the purposes of consumer information, the manufacturer shall make easily available to the owner of the vehicle the most recently determined value of the SOCE monitor via at least one appropriate method. The ~~resolution and~~ method for the customer values shall be determined in agreement with the authorities. For example:

(a) dashboard indicator;

(b) infotainment system;

(c) remote access (such as via mobile-phone applications).

The SOCE value for the purpose of consumer information shall have a resolution of 1 part in 100 as the nearest whole number from 0 to 100.

7.2. Battery Performance Requirements

The battery durability requirements of this Regulation are defined in terms of Minimum Performance Requirements (MPRi), which represent minimum allowable values for SOCE and SOCR at specific points in the lifetime of the vehicle. Vehicles falling under the categories of OVC-HEVs and PEVs shall meet both of the Minimum Performance Requirements in Tables 1 and 2 below. The MPRs may differ depending on the category of the vehicle and type of propulsion.

In order to address regional considerations, a Contracting Party may optionally elect to enforce only one of the two Minimum Performance Requirements (MPRi) in each of the tables below (i.e. either the one ending at 5 years or 100,000 km, or the one ending at 8 years or 160,000 km).

Commented [UK2]: Strictest requirements shall be considered. Levels should be avoided. TBD

Table 1

Battery Energy based (SOCE) MPR

Vehicle age/km for category M in the scope of this Regulation	*OVC-HEV*	*PEV*
From start of life to 5 years or 100,000 km, whichever comes first	80 per cent	80 per cent
Vehicles more than 5 years or 100,000 km, and up to whichever comes first of 8 years or 160,000 km	72 per cent	72 per cent
Vehicle age/km for category N in the scope of this Regulation	*OVC-HEV*	*PEV*
From start of life to 5 years or 100,000 km, whichever comes first	75 per cent	75 per cent
Vehicles more than 5 years or 100,000 km, and up to whichever comes first of 8 years or 160,000 km	67 per cent	67 per cent

Table 2

Range based (SOCR) MPR

Vehicle age/km for category M in the scope of this Regulation	*OVC-HEV*	*PEV*
From start of life to 5 years or 100,000 km, whichever comes first	(Reserved)	(Reserved)
Vehicles more than 5 years or 100,000 km, and up to whichever comes first of 8 years or 160,000 km	(Reserved)	(Reserved)
Vehicle age/km for category N in the scope of this Regulation	*OVC-HEV*	*PEV*
From start of life to 5 years or 100,000 km, whichever comes first	(Reserved)	(Reserved)

Vehicles more than 5 years or 100,000 km, and up to whichever comes first of 8 years or 160,000 km	(Reserved)	(Reserved)

SOCR monitors of vehicles of category M_1 and N_1 vehicles shall be installed and their values monitored in view of setting the values in the tables for part B as well as accuracy requirements in paragraph 6.3 of Part A in a future amendment of this Regulation.

A manufacturer may elect to declare a Declared Performance Requirement (DPRi) having an SOCE and/or SOCR value that is higher than that of the corresponding MPR. The DPRi shall then replace the MPRi for the purposes of determining compliance by that manufacturer.

The manufacturer shall ensure that batteries installed in vehicles comply with the rules specified in paragraph 6.4.2. for the MPRi (or DPRi if applicable).

At the request of the manufacturer and for vehicles designed with V2X or for Category N vehicles used for non-traction purposes, the equivalent virtual distance calculated following the equation below will be reported by each vehicle.

$$Virtual\ distance\ (km) = \left(\frac{total\ discharge\ energy\ during\ V2X\ and\ for\ non-traction\ purposes^{2}\ (Wh)}{worst\ case\ certified\ energy\ consumption\ of\ PART\ B\ family\ (Wh/km)}\right)$$

Where:

"worst case certified energy consumption of Part B family" means the worst case certified energy consumption of a Part B family which needs to be provided according to Annex 4 of this Regulation.

At the option of the manufacturer, instead of using the worst case certified energy consumption value of the Part B family, the manufacturer may be allowed to use any higher energy consumption value.

The total distance used for confirming the compliance with the minimum performance requirements will consist of the sum of the distance driven and the virtual distance. The total virtual distance shall be recorded and monitored.

7.3. Type Approval Authority that grants the approval may request the vehicle manufacture to demonstrate compliance defined in paragraph 7.1. and 7.2. of this section by using the following procedure.

7.3.1. Monitor Requirement (reserved)

7.3.2. Battery Performance Requirements (reserved)

7.4. Without prejudice to paragraph 7.3., the vehicle manufacture may declare the compliance defined in paragraph 7.1. and 7.2. of this section during Type Approval.

7.5. Requirements for SVM and USVM, special purpose vehicles and multi-stage vehicles (reserved)

Commented [OICA 3]: Wording needs to be revised for authorities

Commented [OICA 4]: Transitional provision needed

Commented [OICA 5]: Multi stage vehicles not considered

8. In-~~Use~~ Service ~~Verification~~Conformity

[2] Virtual distance for non-traction purposes to be accounted only for Category N vehicles.

The manufacturer shall perform the in-service conformity tests as described in paragraph 7. Responsible authorities and other third parties bodies may perform in-service verification tests.

~~8.1. Definitions of Families~~

~~Vehicles having the same characteristics with respect to their evaluation under Part A or Part B below shall be grouped into vehicle families for the purpose of compliance verification. Families under Part A shall have the same characteristics with respect to verification of the SOCR/SOCE monitors. Families under Part B shall have the same characteristics with respect to verification of battery durability.~~

~~Families with the same characteristics with respect to compliance verification shall be defined as follows:~~

~~8.1.1. For Part A: Verification of Monitors~~

~~Only vehicles that are substantially similar with respect to the following elements may be part of the same monitor family:~~

~~(a) Algorithm for estimating on-board SOCR and on-board SOCE;~~

~~(b) Sensor configuration (for sensors used in determination of SOCR and SOCE estimates);~~

~~(c) Characteristics of battery cell which have a non-negligible influence on accuracy of monitor;~~

~~(d) Type of vehicle (PEVs or OVC-HEVs).~~

~~At the request of the manufacturer, with the approval of the responsible authority and with appropriate technical justification, the manufacturer may deviate from the above criteria for families.~~

~~8.1.2. For Part B: Verification of Battery Durability~~

~~Only vehicles that are substantially similar with respect to the following elements may be part of the same battery durability family:~~

~~(a) Type and number of electric machines, including net power, construction type (asynchronous/ synchronous, etc.), and any other characteristics having a non-negligible influence on battery durability;~~

~~(b) Type of battery (dimensions, type of cell, including format and chemistry, capacity (Ampere-hour), nominal voltage, nominal power;~~

~~(c) Battery management system (BMS) (with regards to battery durability monitoring and estimations);~~

~~(d) Passive and active thermal management of the battery;~~

~~(e) Type of electric energy converter between the electric machine and battery, between the recharge-plug-in and battery, and any other characteristics having a non-negligible influence on battery durability;~~

~~(f) Operation strategy of all components influencing the battery durability;~~

~~(g) Declared maximum charging power.~~

~~At the request of the manufacturer, with the approval of the responsible authority and with appropriate technical justification, the manufacturer may deviate from the above criteria for families.~~

8.2. Information gathering

The following information shall be made available to the authorities by the manufacturer in a format to be agreed between the authorities and the manufacturer: annual report on relevant warranty claims; and annual statistics on repairs for both batteries and other systems that might influence the electric energy consumption of the vehicle. Such information shall be made available once a year for each battery durability family for the duration of the period defined in paragraph 5.2. after the last vehicle of this family is sold.

8.3. Part A: Verification of SOCR/SOCE monitors

8.3.1. Obligations for the manufacturer

8.3.1.1. Frequency of verifications

The manufacturer shall complete the procedure for in-use verification for Part A with a frequency agreed with the authorities, until ~~5 or~~ 8 years as defined in paragraph 5.2. after the last vehicle of each monitor family is sold and report the results of the verification to the authorities. The authorities may decide to proceed with their own verification of Part A, at a frequency and magnitude based on risk assessment, or request more information from the manufacturers. ~~With the agreement of all Contracting Parties involved, the verification of Part A for vehicles in the same monitor family may be combined between different Contracting Parties. In such cases the relevant Contracting Parties shall be considered as a single authority for the purposes of this verification.~~

The verification of the monitors shall not be mandatory if the annual sales of the monitor family are less than 5 000 vehicles in Contracting Parties applying this Regulation for the previous year. Such families may still be selected to be tested for Part A, at the request of the responsible authorities.

8.3.~~2~~1.2. Verification procedure

In order to verify the SOCR/SOCE monitors, the values for range and usable battery energy shall be measured at the time of the verification and the related values from the monitors shall be collected before the verification test procedure. To support future improvement of the Regulation, indicator values shall be collected again after the verification test procedure. Those indicators read after the verification test procedure shall not be considered in the Part A verification.

The measured SOCR and measured SOCE values shall be determined by dividing the measured values for range and usable battery energy by the certified values for range and usable battery energy, respectively, expressed in per cent.

$$SOCE_{measured} = \frac{UBE_{measured}}{UBE_{certified}} \cdot 100$$

$$SOCR_{measured} = \frac{Range_{measured}}{Range_{certified}} \cdot 100$$

In cases where $UBE_{measured}$ is higher than the $UBE_{certified}$, the $SOCE_{measured}$ shall be set to 100 per cent. In cases where $Range_{measured}$ is higher than the $Range_{certified}$, the $SOCR_{measured}$ shall be set to 100 per cent.

8.3.~~3~~1.3. Statistical Method for Pass/Fail decision for a sample of vehicles

Separate statistics shall be calculated for the SOCR monitor and the SOCE monitor.

An adequate number of vehicles (at least 3 and not more than 16) shall be selected from the same monitor family for testing following a vehicle survey (see Annex 3 of this Regulation) which contains information designed to ensure that the vehicle has been properly used and maintained according to the specifications of the manufacturer. The following statistics shall be used to take a decision on the accuracy of the monitor.

For evaluating the SOCR/SOCE monitors normalised values shall be calculated:

$$x_i = SOC_{read,i} - SOC_{measured,i}$$

Where

$SOC_{read,i}$ is the on-board SOCR/SOCE read from the vehicle i ; and

$SOC_{measured,i}$ is the measured SOCR/SOCE of the vehicle i.

For the total number of N tests and the normalised values of the tested vehicles, x_1, x_2, … x_N, the average X_{tests} and the standard deviation s shall be determined:

$$x_{tests} = \frac{(x_1 + x_2 + x_3 + \cdots + x_N)}{N}$$

and

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

For each N tests $3 \leq N \leq 16$, one of the three following decisions can be reached, where the factor A shall be set at 5:

(a) Pass the family if $x_{tests} \leq A - (t_{P1,N} + t_{P2,N}) \cdot s$

(b) Fail the family if $x_{tests} > A + (t_{F1,N} - t_{F2}) \cdot s$

(c) Take another measurement if:

$$A - (t_{P1,N} + t_{P2,N}) \cdot s < X_{tests} \leq A + (t_{F1,N} - t_{F2}) \cdot s$$

where the parameters $t_{P1,N}$, $t_{P2,N}$, $t_{F1,N}$, and t_{F2} are taken from Table 3.

As at the current stage no accuracy requirements are set for the SOCR monitor, separate statistics for the SOCR monitors shall not be calculated for verification purposes. Separate statistics for the SOCR monitor shall be calculated once accuracy requirements are set for Part A in a future amendment of this Regulation.

Table 3
Pass/fail decision criteria for the sample size

	PASS		*FAIL*	
Tests (N)	$t_{P1,N}$	$t_{P2,N}$	$t_{F1,N}$	t_{F2}
3	1.686	0.438	1.686	0.438
4	1.125	0.425	1.177	0.438
5	0.850	0.401	0.953	0.438
6	0.673	0.370	0.823	0.438
7	0.544	0.335	0.734	0.438
8	0.443	0.299	0.670	0.438
9	0.361	0.263	0.620	0.438
10	0.292	0.226	0.580	0.438
11	0.232	0.190	0.546	0.438
12	0.178	0.153	0.518	0.438
13	0.129	0.116	0.494	0.438
14	0.083	0.078	0.473	0.438
15	0.040	0.038	0.455	0.438
16	0.000	0.000	0.438	0.438

8.3.1.4. Corrective measures for the SOCR and SOCE monitors

A fail decision for the sample means that the monitors fail to report accurately the durability of the system and appropriate action shall be taken by the manufacturer with the agreement of the responsible authority. This may lead to the requirement that the manufacturer repairs or replaces the faulty monitor including the relevant sensors or by applying software measures in all affected vehicles in the monitor family.

A pass decision or correction of the non-compliance is required for proceeding with Part B.

SOCR monitors shall not lead to a fail decision but shall be monitored in view of setting the accuracy requirements for Part A in a future amendment of this Regulation.

~~8.3.1.5 The manufacturer shall provide to the responsible authorities a certificate of compliance which declares that the vehicle type complies with the requirements as stated in Annex 7.2.~~

~~8.3.1.6. Manufacturer's Battery Durability certificate of compliance template (reserved)~~

8.3.2. The responsible authority may decide to conduct Part A test as described in the paragraphs from 8.3.1.1. to 8.3.1.4. (tb decided by EU COM)

8.4. Part B: Verification of Battery Durability

8.4.1. Obligations of the manufacturers:

Commented [UK6]: 1958 Agreement includes rules regarding non-compliance. Delete this paragraph

Commented [OICA 7R6]: This paragraph was added to cover minor (software) issues without the manufacturer beeing forced to recall vehicles.

8.4.1.1. Frequency of verifications

Data shall be collected yearly by the ~~authorities~~ manufacturer from a statistically adequate sample of vehicles within the same battery durability family selected randomly from a variety of climate conditions. The decision on the number of the vehicles in the sample may be taken by the ~~responsible authority~~manufacturer~~-~~ based on risk assessment methodology, but in principle should not be less than 500.

If the number of vehicles in the sample is less than 500, ~~then on the request of the manufacturer and with the agreement of the responsible authority,~~ a maximum of 5 per cent of the values may be excluded from the sample. In such a case, the manufacturer needs to ~~provide adequate information on the reason behind the exclusion for each vehicle to the authority~~use good engineering judgement.

If the number of vehicles in the sample is equal to or more than 500, then all vehicles shall be included in the sample. The data read shall be those of the SOCR and SOCE monitors (and other relevant data, such as those defined in Annex 4). SOCR ~~and SOCE~~ monitors of vehicles of category N and SOCR monitors of category M vehicles shall be collected only for monitoring purposes as long as Table 2 of Annex 4 does not contain any MPR's for SOCR ~~monitored~~.

8.4.1.2. The manufacturer shall provide to the responsible authorities a certificate of compliance which declares that the vehicle type complies with the requirements as stated in Annex 7.3.

8.4.2. The responsible authority of a contracting party applying this regulation may decide to perform a Part B verification. In this case the manufacturer shall make available the yearly collected data to the authorities in a format agreed with the authorities. From that data, a statistically adequate sample of vehicles within the same battery durability family shall be selected randomly from a variety of climate conditions. The decision on the number of the vehicles in the sample may be taken by the responsible authority based on risk assessment methodology, but in principle should not be less than 500.

If the number of vehicles in the sample is less than 500, then on the request of the manufacturer and with the agreement of the responsible authority, a maximum of 5 per cent of the values may be excluded from the sample. In such a case, the manufacturer needs to provide adequate information on the reason behind the exclusion for each vehicle to the authority.

If the number of vehicles in the sample is equal to or more than 500, then all vehicles shall be included in the sample. The data read shall be those of the SOCR and SOCE monitors (and other relevant data, such as those defined in Annex 4). SOCR monitors of vehicles of category N and SOCR monitors of category M vehicles shall be collected only for monitoring purposes as long as Table 2 of Annex 4 does not contain any MPR's for SOCR.

8.4.2. Pass/Fail Criteria for the battery durability family

A battery durability family shall pass if equal to or more than 90 per cent of monitor values read from the vehicle sample are above the MPR*i* or DPR*i*.A battery durability family shall fail if less than 90 per cent of monitor values read from the vehicle sample are above the MPR*i* or DPR*i*.

Commented [UK8]: Definition required?

~~8.4.3. Corrective Measures for the Battery Durability Family~~

~~In case of a fail for a battery durability family, corrective measures shall be taken with the agreement of the responsible authority in order to bring the family or part of the family affected by the issue into compliance.~~

Commented [UK9]: 1958 Agreement includes rules regarding non-compliance.

8.5. Part C: Verification of reported virtual distance

8.5.1. Verification procedure

A verification of the reported virtual distance is only required if the manufacturer is requesting to apply the equivalent virtual distance option. In order to verify the virtual distance read from the vehicle, a test shall be performed with adequate and representative use of the vehicle in V2X or non-traction purposes, if applicable, to verify whether the increase in virtual distance reported is accurate. The total discharge energy during this use shall be measured in order to calculate the measured virtual distance. The verification procedure use case (including the minimum amount of discharged energy corresponding to at least 50 km virtual distance. ~~If 50 km virtual distance cannot be reached with a fully charged battery, virtual distance required for verification shall be set to a value recommended by the manufacturer)~~ This shall be agreed and approved by the responsible authority. If 50 km virtual distance cannot be reached with a fully charged battery, virtual distance required for verification shall be set to a value recommended by the manufacturer.

Table 4
The following steps shall be performed to determine the necessary verification results:

Step nr.	Input	Description	Output
Step 1	n.a.	Read the initial virtual distance and the worst case certified energy consumption of Part B family according to Annex 4	$d_{virt,on\text{-}board,init}$ (km) $EC_{Part\ B}$ (Wh/km)
Step 2	n.a.	Perform the V2X-use case and measure the discharged energy	$E_{V2X,meas}$ (Wh)
Step 3	n.a.	Read the final virtual distance according to Annex 4	$d_{virt,on\text{-}board,final}$ (km)
Step 4	From Step 1: $d_{virt,on\text{-}board,init}$ (km) $EC_{Part\ B}$ (Wh/km) From Step 2: $E_{V2X,meas}$ (Wh) From Step 3: $d_{virt,on\text{-}board,final}$ (km)	Calculate the delta of on-board virtual distance: $\Delta d_{virt,onboard} = d_{virt,onb,final} - d_{virt,onb,init}$ Calculate the measured virtual distance: $\Delta d_{virt,meas} = \frac{E_{V2X,meas}}{EC_{Part\ B}}$	$\Delta d_{virt,on\text{-}board}$ (km) $\Delta d_{virt,meas}$ (km)

8.5.2. Pass or fail of reported virtual distance

An agreed verification procedure use case (as mentioned in paragraph 6.5.1.) shall be performed with an adequate number of vehicles (at least 1 and not more than 4) used in V2X or ~~not~~non-traction purposes. The verification of the reported virtual distance shall lead to a fail in the verification procedure if the reported delta virtual distance $\Delta d_{virt,on\text{-}board}$ according to Table 4 is more than 5~~%~~ per cent higher than the measured virtual distance $\Delta d_{virt,meas}$ according to Table 4.The following statistics shall be used to take a decision on the accuracy of the virtual distance.

For the purposes of deciding on a pass/fail result for the sample, 'p' is the count of passed results, and 'f' is the count of failed results. Each passed test result shall increase the 'p' count by 1 and each failed test result shall increase the 'f' count by 1 for the relevant open statistical procedure.

Upon the incorporation of valid V2X energy test results to an open instance of the statistical procedure, the responsible authority shall perform the following actions:

(a) update the cumulative sample size 'n' for that instance to reflect the total number of valid tests incorporated to the statistical procedure;

(b) following an evaluation of the results, update the count of passed results 'p' and the count of failed results 'f';

(c) check whether a decision is reached with the procedure described below.

The decision depends on the cumulative sample size 'n', the passed and failed result counts 'p' and 'f'. For the decision on a pass/fail of a verification sample the responsible authority shall use the decision chart in Table 5. The chart indicates the decision to be taken for a given cumulative sample size 'n' and failed count result 'f'.

Two decisions are possible for a statistical procedure for a given vehicle family:

(a) 'Sample pass' outcome shall be reached when the decision chart from Table 5 gives a "PASS" outcome for the current cumulative sample size 'n' and the count of failed results 'f'.

(b) 'Sample fail' decision shall be reached when, for a given cumulative sample size 'n', when the applicable decision chart from Table 5 gives a "FAIL" decision for the current cumulative sample size 'n' and the count of failed results 'f'.

If no decision is reached, the statistical procedure shall remain open and further results shall be incorporated into it until a decision is reached.

Table 5 Decision chart for Part C pass/fail verification

Failed result count 'f'					
	3			FAIL	FAIL
	2		UND	UND	PASS
	1	UND	PASS	PASS	PASS
	0	PASS	PASS	PASS	PASS
		1	2	3	4
				n	

Note: 'UND' means undecided

8.5.3. Corrective measures for reported virtual distance

A fail decision for the sample means that the virtual distance calculators (algorithm) fail to report accurately the virtual distance of the system and appropriate action shall be taken by the manufacturer with the agreement of the responsible authority. This may lead to the requirement that the manufacturer repairs or replaces the faulty virtual distance calculator in all affected and future vehicles in the battery durability family, to correct already reported virtual distances for this family and to repeat the procedure for verification of Part B in order to confirm the pass or fail.

8.6. Process flow charts for Part A and Part B

The flow charts below illustrate the various steps in the verification process of Part A (Figure 1) and Part B (Figure 2).

Figure 1
Flow chart for Part A: Verification of Monitors

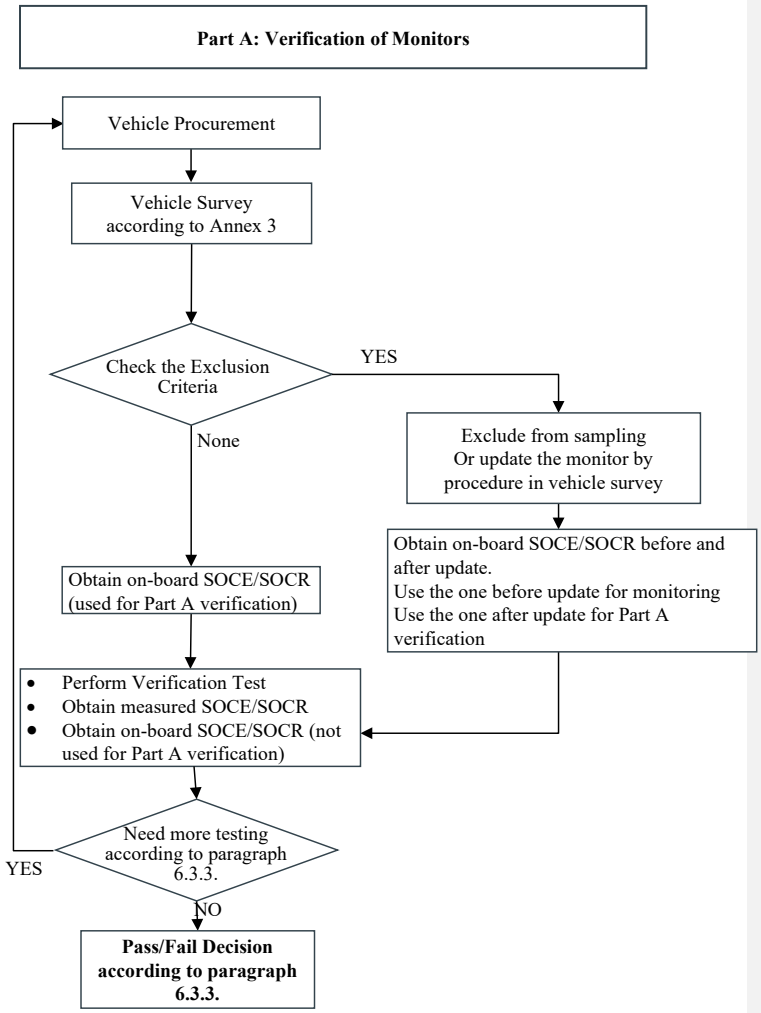
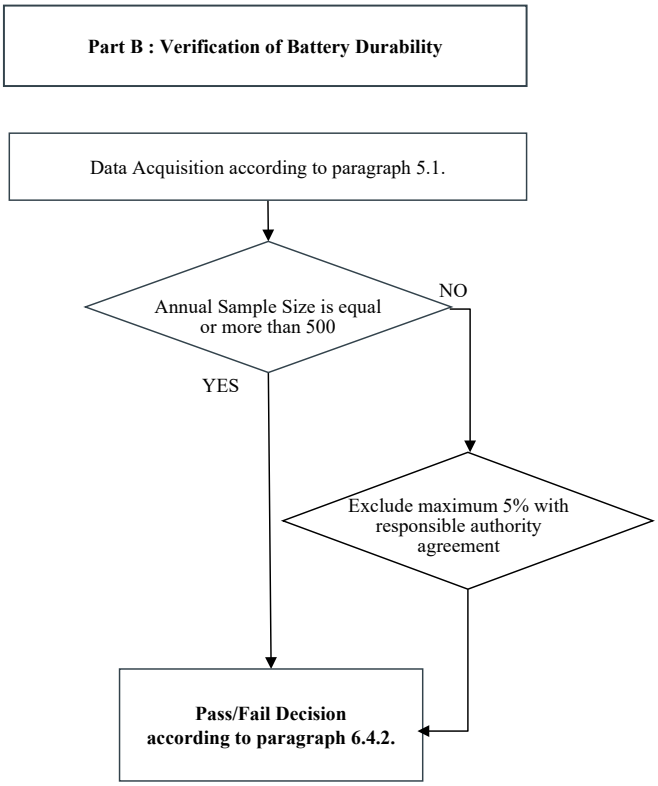


Figure 2
Flow chart for Part B : Verification of Battery Durability



9. Rounding

9.1. When the digit immediately to the right of the last place to be retained is less than 5, that last digit retained shall remain unchanged.

Example:

If a result is 1.2344 kWh but only three places of decimal are to be retained, the final result shall be 1.234 kWh.

9.2. When the digit immediately to the right of the last place to be retained is greater than or equal to 5, that last digit retained shall be increased by 1.

Example:

If a result is 1.2346 kWh but only three places of decimal are to be retained, and because 6 is greater than 5, the final result shall be 1.235 kWh.

10. Modification and extension of the ~~type approval~~type-approval

10.1. Every modification of the vehicle type shall be notified to the Type Approval Authority that approved the vehicle type. The Type Approval Authority may then either:

10.1.1. Consider that the modifications made are contained within the families covered by the approval or are unlikely to have an appreciable adverse effect on the ~~Type Approval~~type-approval values and that, in this case, the original approval will be valid for the modified vehicle type; or

10.1.2. Require a further test report from the Technical Service responsible for conducting the tests.

10.2. Confirmation or refusal of approval, specifying the alterations, shall be communicated by the procedure specified in paragraph 5.3. to the Contracting Parties to the Agreement which apply this Regulation.

10.3. The Type Approval Authority issuing the extension of approval shall assign a series number to the extension and inform thereof the other Contracting Parties to the 1958 Agreement applying this Regulation by means of a communication form conforming to the model in Annex 2 to this Regulation.

10.4. Extension of an approval

An existing ~~type approval~~type-approval may be extended e.g. by adding new vehicle families to it. The added families must also fulfil the requirements of paragraph X.X. This may require further verification by the Type Approval Authority.

11. Conformity of production

11.1. Vehicles approved under this Regulation shall be so manufactured as to conform to the type approved. The conformity of production procedures shall comply with those set out in the Agreement, Appendix 2 (E/ECE/324 — E/ECE/TRANS/505/Rev.2). ~~The conformity of production requirements . . . . .~~

12. Penalties for non-conformity of production

12.1. The approval granted in respect of a vehicle type pursuant to this Regulation, may be withdrawn if the requirements described in paragraph 11. of this Regulation are not complied with.

12.2. If a Contracting Party to the 1958 Agreement which applies this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a communication form conforming to the model in Annex 2 to this Regulation.

13. Production definitively discontinued

13.1. If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, they shall so inform the Type-

Approval Authority which granted the approval. Upon receiving the relevant communication, that Authority shall inform thereof the other Contracting Parties to the 1958 Agreement applying this Regulation by means of copies of the communication form conforming to the model in Annex 2 to this Regulation.

14. Names and addresses of the Technical Services responsible for conducting approval tests and of Type Approval Authorities

14.1. The Contracting Parties to the 1958 Agreement which apply this Regulation shall communicate to the United Nations Secretariat the names and addresses of the Technical Services responsible for conducting approval tests and of the Type Approval Authorities which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval, issued in other countries, are to be sent.

Annex 1

Communication

(Maximum format: A4 (210 x 297 mm)

issued by : (Name of administration)
.....
.....
.....

concerning[3]: Approval granted
Approval extended
Approval refused
Approval withdrawn
Production definitively discontinued

of determination of system power of hybrid electric vehicles and of pure electric vehicles having more than one electric machine for propulsion.

Approval No.: ..... Extension No.: .....

1. Manufacturer's name or trade mark(s):……
2. Type designation by the manufacturer
3. Manufacturer's name and address .....
4. If applicable, name and address of manufacturer's representative .....
5. Summarised description:.....

[3] Strike out what does not apply

Annex 1 Appendix 1

Vehicle characteristics and information concerning the conduct of tests

The following information, when applicable, shall be supplied in triplicate and include a list of contents.

If there are drawings, they shall be to an appropriate scale and show sufficient detail; they shall be presented in A4 format or folded to that format. Photographs, if any, shall show sufficient detail.

0	GENERAL
0.1.	Make (trade name of manufacturer): …
0.2.	Type: …
0.2.1.	Commercial name(s) (if available): …
0.2.3.	Family identifiers:
0.2.3.12.	Battery durability family: …

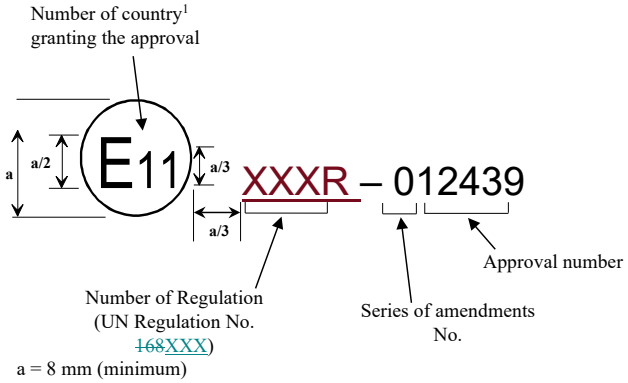
Annex 2

Arrangement of the approval mark

In the approval mark issued and affixed to a vehicle in conformity with paragraph 5. of this Regulation, the ~~type approval~~type-approval number shall be accompanied by an alphanumeric character reflecting the level that the approval is limited to.

This annex outlines the appearance of this mark and gives an example how it shall be composed.

The following schematic graphic presents the general lay-out, proportions and contents of the marking. The meaning of numbers and alphabetical character are identified, and sources to determine the corresponding alternatives for each approval case are also referred.



a = 8 mm (minimum)

The following graphic is a practical example of how the marking should be composed.

Annex 3

Vehicle Survey

The vehicle survey shall be used for all vehicles selected for testing in Part A of the verification. Vehicles that fall under one of the exclusion criteria below shall be eliminated from testing, or otherwise updated according to the procedures described below.

	x = Exclusion Criteria	**x = Checked and reported**	**Confidential**
Date:			**x**
Name of investigator:			**x**
Location of test:			**x**
Country of registration:		**x**	

Vehicle Characteristics

	x = Exclusion Criteria	**x = Checked and reported**	**Confidential**
Registration plate number:		**x**	**x**
*The vehicle must have both **'age' and 'distance travelled'** (defined as the time elapsed after manufacture) below the ones required in paragraph 5.2. for the MPR verification*	**x**		
Is the vehicle either PEV or OVC-HEV? If no: the vehicle cannot be selected	**x**		
Date of manufacture:		**x**	

[VIN:		**x]**	
Emission class and character or Model Year		**x**	
Country of registration: *The vehicle must be registered in a Contracting Party*	**x**	**x**	
Model:		**x**	
Engine code (where applicable):		**x**	
Engine capacity (l) (where applicable):		**x**	
Engine power (kW) (where applicable):		**x**	
Electric motor code:		**x**	
Electric motor power (kW):		**x**	
Electric powertrain type		**x**	

Energy capacity and type of battery		**x**	
Gearbox type (auto/manual):		**x**	
Drive axle (FWD/AWD/RWD):		**x**	
Tyre size (front and rear if different):		**x**	
Average fuel consumption for OVC-HEVs		**x**	
Has the vehicle been involved in a recall or service campaign? **If yes: Which one? Have the campaign repairs already been done?** *The repairs must have been done before selecting the vehicle.*	**x**	**x**	

Vehicle Owner Interview
(the owner will only be asked the main questions and shall have no knowledge of the implications of the replies)

Name of the owner (only available to the accredited inspection body or laboratory/technical service)			x
Contact (address / telephone) (only available to the accredited inspection body or laboratory/technical service)			x

How many owners did the vehicle have?		**x**	
Did the odometer always work? *If no, the vehicle cannot be selected.*	**x**		
Was the vehicle used for one of the following?			
As car used in show-rooms?		**x**	
As a taxi?		**x**	
As a delivery vehicle?		**x**	
For racing / motor sports?	**x**		
As a rental car?		**x**	
Has the vehicle carried heavy loads over the specifications of the manufacturer? *If yes, the vehicle cannot be selected.*	**x**		
Have there been major engine, electric motor or vehicle repairs?		**x**	
Have there been unauthorised major engine or vehicle repairs? *If yes, the vehicle cannot be selected.*	**x**		
Was the propulsion battery changed or repaired? *If yes, the vehicle cannot be selected for testing, but information should be collected*	**x**	**x**	
Has there been an unauthorised power increase/tuning? *If yes, the vehicle cannot be selected.*	**x**		
Was any part of the emissions after-treatment system modified (where applicable)? *If yes, the vehicle cannot be selected*	**x**		
Where do you use your vehicle more often?	-	-	-
% motorway	-	**x**	-

Commented [UK10]: To consider rephrasing it alignment with e-HDV GTR
"Where has your vehicle been used more often?"

or to be more prescriptive

"What is the approximate percentage split of your driving between motorway, rural roads and urban roads?

Are we referring to mileage or time spent?

% rural	-	x	-
% urban	-	x	-
Has the vehicle been maintained and used in accordance with the manufacturer's instructions? *If not, the vehicle cannot be selected.*	x		
Is a full service and repair history including any re-works available? *If the full documentation cannot be provided, the vehicle cannot be selected.*	x		
Battery related checks:			
How often did you charge the vehicle when:			
%with battery almost at 0 charge	-	x	
%with battery half charged	-	x	
%with battery almost fully charged	-	x	
On average how often were fast or superfast chargers used per month?		x	
What is your estimation of the percentage of time that the vehicle was used in the following ambient temperature ranges:			
Below -7°C:		x	
Between -7°C and 35°C:		x	
More than 35°C:		x	

Vehicle Examination and Maintenance by the Testing Centre (please use the relevant entries according to the type of vehicle)	**x= Exclusion Criteria**	**x=checked and reported**	**Relevant for PEV**
When was the vehicle last adequately* charged? *If the vehicle has not been charged adequately during the last month (as evidenced by values read from the vehicle under point 9, Annex 4), then it has to be conditioned before testing by driving the vehicle no less than 50 km and in a manner that results in discharge of at least 50 per cent of the usable capacity of the battery, followed by a full recharge.* Note: * Adequately in this sense means that the vehicle was not charged in a manner stated by the manufacturer that would lead to an accurate SOCE/SOCR	x		x
Fuel tank level (full / empty) (where applicable) Is the fuel reserve light ON? *If yes, refuel before test.*		x	
Are there any warning lights on the instrument panel activated indicating a vehicle or exhaust after-treatment system malfunctioning (where applicable) that cannot be resolved by normal maintenance? (Malfunction Indication Light, Engine Service Light, etc?) *If yes, the vehicle cannot be selected*	x		
Is the SCR light (where applicable) on after engine-on? *If yes, the reagent should be filled, or the repair executed before the vehicle is used for testing.*	x		
Visual inspection exhaust system (where applicable) Check leaks between exhaust manifold and end of tailpipe. Check and	x		

document (with photos) *If there is damage or leaks, the vehicle cannot be tested*			
Exhaust gas relevant components (where applicable) Check and document (with photos) all emissions relevant components for damage. *If there is damage, the vehicle cannot be tested*	**x**		
Air filter and oil filter (where applicable) Check for contamination and damage. Change if damaged or heavily contaminated or less than 800 km before the next recommended change.		**x**	
Wheels (front & rear) Check whether the wheels are freely moveable or blocked or impeded by the brake. *If not freely moveable, the vehicle cannot be selected.*	**x**		**Y**
Drive belts & cooler cover *In case of damage, the vehicle cannot be tested.*	**x**		
Check fluid levels (where applicable) Check the max. and min. levels (engine oil, cooling liquid) / top up if below minimum		**x**	
Vacuum hoses and electrical wiring Check all for integrity. *In case of damage, the vehicle cannot be tested.*	**x**		**Y**
Injection valves / cabling (where applicable) Check all cables and fuel lines. *In case of damage, the vehicle cannot be tested.*	**x**		**Y**
Ignition cable (gasoline) (where applicable) Check spark plugs, cables, etc. In case of damage, replace them.		**x**	
EGR & Catalyst, Particle Filter (where applicable) Check all cables, wires and sensors. *In case of tampering or damage, the vehicle cannot be selected.*	**x**		
Safety condition Check tyres, vehicle's body, electrical and braking system status are in safe conditions for the test and respect road traffic rules. *If not, the vehicle cannot be selected.*	**x**		**Y**
Semi-trailer Are there electric cables for semi-trailer connection, where required?		**x**	**Y**
Check if less than 800 km away from next scheduled service, if yes, then perform the service.		**x**	**Y**
Powertrain Control Module calibration part number and checksum		**x**	**Y**
OBD diagnosis (before or after the range test) Read Diagnostic Trouble Codes & Print error log		**x**	

OBD Service Mode 09 Query (before or after the range test) Read Service Mode 09. Record the information.		**x**	
OBD mode 7 (before or after the range test) Read Service Mode 07. Record the information		**x**	

Remarks for: Repair / replacement of components / part numbers

Annex 4

Values to be read from vehicles:

Mandatory values:

1. On board SOCE value ~~(in %)~~ [%]
2. On board SOCR value ~~(in %)~~[%]
3. Odometer (i.e. distance driven by the vehicle) ~~(in km)~~[km]
4. Date of manufacture of the vehicle
5. Elapsed time since last charged by more than 50 per cent SOC swing ~~(Days)~~[days]
6. Average battery temperature while propulsion system is active, during charging and (if equipped) during non-usage of the vehicles (i.e. non-propulsion system active, non-charging)

Values required if manufacturer applies virtual distance option:

7. Total distance (sum of the distance driven as reported by the odometer and the virtual distance) ~~(km)~~[km]
8. Virtual distance ~~(km)~~[km]
9. Worst case certified energy consumption of PART B family [~~(~~Wh/km~~)~~]
10. Total discharge energy in V2X [~~(~~kWh~~)~~]
11. Total discharge energy for non-traction purposes [~~(~~kWh~~)~~], only applicable for category 2 vehicles and if requested by the manufacturer

Values that may be required by regional regulations:

12. Energy throughput [~~(~~kWh~~)~~]

Annex 5

Determination of Performance Parameter during Part A Test Procedure

1. General

For the calculation of $SOCE_{measured}$ and $SOCR_{measured}$ according to paragraph 6.3.2. of this Regulation, the measured and certified values of usable battery energy (UBE) and electric range (PER for PEVs and EAER for OVC-HEVs) are required:

- $UBE_{measured}$ and $UBE_{certified}$
- $Range_{measured}$ and $Range_{certified}$

This annex describes the determination of these parameters in case of WLTP, in paragraph 2. for PEVs and in paragraph 3. for OVC-HEVs and gives guidance on which measurements need to be performed and which certified values need to be applied for a vehicle selected in the Part A verification procedure. Regions that do not apply ~~[UN GTR No. 15 (GTR15) or]~~ UN Regulation No. 154, shall define an alternative solution informed by the guidance below.

For the purposes of this annex, for PEVs the term 'battery' includes not only REESS used mainly for traction purposes, but also all other REESSs.

2. Performance parameters for PEVs

2.1. UBE for PEVs

2.1.1. Measured UBE values for PEVs

Parameters	*Explanation*	
$UBE_{measured}$	Shortened Test Procedure (STP)	Consecutive Cycle Procedure (CCP)
	UBE value shall be determined according to UN-R154 Annex 8, Table A8/11 Step no. 1.	UBE value shall be determined according to UN-R154 Annex 8, Table A8/10 Step no. 1.
	No rounding shall be applied on $UBE_{measured}$.	

2.1.2. Certified UBE values for PEVs

Parameters	*Explanation*	
$UBE_{certfied}$	Shortened Test Procedure (STP)	Consecutive Cycle Procedure (CCP)

Parameters	*Explanation*	
	$UBE_{certified}$ is the adjusted measured usable battery energy (UBE) of the vehicle at certification: $UBE_{certified} = UBE_{measured} * AF_{PER}$ where: $UBE_{measured}$ is the measured usable battery energy according to UN-R154 Annex 8, Table A8/11 Step no.1 at certification. In the case of more than one test (number of tests), the determined UBE values shall be averaged. AF_{PER} is the adjustment factor determined according to UN-R154, Annex 8, Table A8/11 Step no. 6.	$UBE_{certified}$ is the adjusted measured usable battery energy (UBE) of the vehicle at certification: $UBE_{certified} = UBE_{measured} * AF_{PER}$ where: $UBE_{measured}$ is the measured usable battery energy according to UN-R154 Annex 8, Table A8/10 Step no.1 at certification. In the case of more than one test (number of tests), the determined UBE values shall be averaged. AF_{PER} is the adjustment factor determined according to UN-R154, Annex 8, Table A8/10 Step no. 7.
	$UBE_{certfied}$ shall be rounded according to paragraph 7 of this Regulation: - To the nearest whole number ~~in case~~if the unit is Wh - To three significant numbers ~~in case~~if the unit is kWh	
	In the case the interpolation method is applied, $UBE_{certified}$ shall be determined by selecting - The maximum $UBE_{measured}$ xAF) amongst vehicle H and vehicle L;	

2.2. Range for PEVs

2.2.1. Measured Range values for PEVs

Parameters	*Explanation*	
$Range_{measured}$	Shortened Test Procedure (STP)	Consecutive Cycle Procedure (CCP)
	Range value (PER_{WLTC}) shall be determined according to UN-R154 Annex 8, Table A8/11, Step no. 4.	Range value (PER_{WLTC}) shall be determined according to UN-R154 Annex 8, Table A8/10, step no. 5.
	No rounding shall be applied on $Range_{measured}$.	

2.2.2. Certified Range values for PEVs

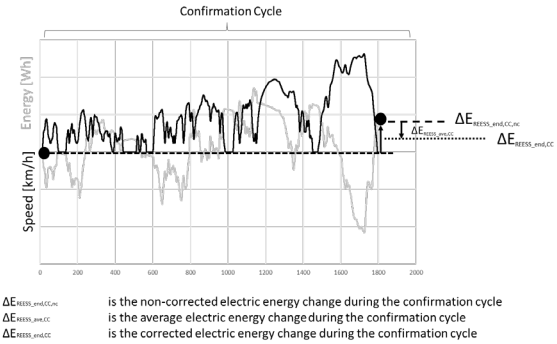
Parameters	*Explanation*	
$Range_{certified}$	Shortened Test Procedure (STP)	Consecutive Cycle Procedure (CCP)
	Range value (PER_{WLTC}) according to UN-R154 Annex 8, Table A8/11 Step no.6. or 9†.	Range value (PER_{WLTC}) according to UN-R154 Annex 8, Table A8/10 Step no.7. or 10†.
	$Range_{certified}$ shall be rounded to the nearest whole number according to paragraph 7 of this Regulation.	

Note: †depending on whether the interpolation method is applied or not

3. Performance parameters for OVC-HEVs

3.1. UBE for OVC-HEVs

3.1.1. Measured UBE values for OVC-HEVs

Parameters	*Explanation*
$UBE_{measured}$	$UBE_{measured}$ shall be the usable battery energy calculated as follows: $$UBE_{measured} = UBE_{measured,nc} - \Delta E_{REESS,CC_{ave}}$$ Where: $UBE_{measured,nc}$ is the non-corrected usable battery energy of the charge-depleting test, (Wh); $\Delta E_{REESS,CC_{ave}}$ is the average electric energy change of the confirmation cycle, (Wh); CC means confirmation cycle as defined in UN-R154 Annex 8, paragraph 3.2.4.4.. The correction with the average electric energy change in the confirmation cycle is required as the break-off criterion, according to UN-R154 Annex 8, paragraph 3.2.4.5., allows a toggling around the absolute reference level. The correction shall compensate for this effect and is visualized in the following figure:  $\Delta E_{REESS\_end,CC\_nc}$ is the non-corrected electric energy change during the confirmation cycle $\Delta E_{REESS\_ave,CC}$ is the average electric energy change during the confirmation cycle $\Delta E_{REESS\_end,CC}$ is the corrected electric energy change during the confirmation cycle
	The required input parameter $UBE_{measured,nc}$ is calculated as follows: $$UBE_{measured,nc} = \sum_{i=1}^{n} \Delta E_{REESS,i}$$ where: $\Delta E_{REESS,i}$ is the measured electric energy change of battery i, (Wh); i is the index number of the considered battery; n is the total number of batteries; and: $$\Delta E_{REESS,i} = \frac{1}{3600} \times \int_{t_0}^{t_{end}} U(t)_{REESS,i} \times I(t)_{REESS,i}\, dt$$ where: $U(t)_{REESS,i}$ is the voltage of battery i, V; $I(t)_{REESS,i}$ is the electric current of battery i, A; t_0 is the time at the beginning of the charge-depleting test, s;

Parameters	*Explanation*
	t_{end} is the time at the end of the confirmation cycle of the charge-depleting test, s; $\frac{1}{3600}$ is the conversion factor from Ws to Wh.
	The required input parameter $\Delta E_{REESS,CC,ave}$ is calculated as follows: $$\Delta E_{REESS.CC,ave} = \sum_{i=1}^{n} \Delta E_{REESS,avg,i,CC}$$ Where: $\Delta E_{REESS,avg,i,CC}$ is the average of the measured electric energy change of battery *i* during the confirmation cycle, (Wh); i is the index number of considered battery; n is the total number of batteries; and $$\Delta E_{REESS,avg,i,CC} = \frac{1}{3600} \times \frac{1}{t_{end,CC} - t_{start,CC}} \times \int_{t_{start,CC}}^{t_{end,CC}} \int_{t_{start,CC}}^{t} U_{REESS,i}(t) \times I_{REESS,i}(t) dt\, dt$$ where: $U_{REESS,i}(t)$ is the voltage of battery *i*, in V $I_{REESS,i}(t)$ is the current of battery *i*, in A $t_{start,CC}$ is the time at the beginning of the confirmation cycle of the charge-depleting test, s; $t_{end,CC}$ is the time at the end of the confirmation cycle of the charge-depleting test, s; $\frac{1}{3600}$ is the conversion factor from Ws to Wh. CC means confirmation cycle as defined in UN-R154 Annex 8, paragraph 3.2.4.4.
No rounding shall be applied on $UBE_{measured}$.	

Commented [EC11]: To be corrected

3.1.2. Certified UBE values for OVC-HEVs

Parameters	*Explanation*
$UBE_{certified}$	$UBE_{certified}$ is the adjusted measured usable battery energy (UBE) of the vehicle at certification: $$UBE_{certified} = UBE_{measured} * AF_{OVC-HEV}$$ Where: $UBE_{measured}$ is the measured usable battery energy at certification according to paragraph 3.1.1. of this annex, Wh; $AF_{OVC-HEV}$ is the adjustment factor determined as described below. At the option of the Contracting Party, one out of the following two adjustment factors shall be selected: - Adjustment factor 1: $AF_{OVC-HEV} = \frac{EC_{measured}}{EC_{certified}}$ where: $EC_{certified}$ is the electric energy consumption $EC_{AC.CD}$ according to UN-R154 Annex 8, Table A8/8, Step no. 14 at certification, Wh/km; $EC_{measured}$ is the measured electric energy consumption $EC_{AC,CD}$ according to UN-R154 Annex 8, Table A8/8, Step no. 13 at certification. Wh/km. - Adjustment factor 2: $AF_{OVC.HEV} = \frac{EC_{measured}}{EC_{certified}}$ where: $EC_{certified}$ is EC according to UN-R154 Annex 8, Table A8/9, Step no. 8 at certification, Wh/km; $EC_{measured}$ is measured EC according to UN-R154 Annex 8, Table A8/9, Step no. 7 at certification. Wh/km.
	$UBE_{certfied}$ shall be rounded according to paragraph 7 of this Regulation: - To the nearest whole number ~~in case~~if the unit is Wh - To three significant numbers ~~in case~~if the unit is kWh
	In the case the interpolation method is applied, $UBE_{certified}$ shall be determined by selecting: - The maximum ($UBE_{measured}$ xAF) amongst vehicle H and vehicle L and (if applicable) vehicle M.

3.2. Range for OVC-HEVs

3.2.1. Measured range values for OVC-HEVs

Parameters	*Explanation*
$Range_{measured}$	$Range_{measured}$ is the measured equivalent all-electric range as defined in the equation below: $$\boldsymbol{EAER_{measured} = \left(\frac{M_{CO2,CS} - M_{CO2,CD,avg}}{M_{CO2,CS}}\right) \times R_{cdc}}$$ where:

	$M_{CO2,CD,avg}$	**is the arithmetic average charge-depleting CO_2 mass emission according to [UN-R154, Annex 8, Paragraph 4.4.4.1., g/km;]**
	$M_{CO2,CS}$	is the charge-sustaining CO_2 mass emission according to UN-R154, Annex 8, Table A8/5 Step no. 5, g/km;
	R_{CDC}	is the measured length of the charge-depleting test according to UN-R154, Annex 8, Table A8/8, Step no. 3, km;
	No rounding shall be applied on $Range_{measured}$.	

3.2.2. Certified range values for OVC-HEVs

Parameters	*Explanation*
$Range_{certified}$	$Range_{certified}$ (EAER) according to UN Regulation No. 154, Series of amendments 02 or later, Annex B8, Table A8/9 Step no. 8 or 9† at certification.
	$Range_{certified}$ shall be rounded to the nearest whole number according to paragraph 7 of this Regulation.

Note: †depending on whether the interpolation method is applied or not

Annex XX

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

The following information, when applicable, shall be supplied in triplicate and include a list of contents.

If there are drawings, they shall be to an appropriate scale and show sufficient detail; they shall be presented in A4 format or folded to that format. Photographs, if any, shall show sufficient detail.

If the systems, components or separate technical units have electronic controls, information concerning their performance shall be supplied.

0	GENERAL
0.1.	Make (trade name of manufacturer): …
0.2.	Type: …
0.2.1.	Commercial name(s) (if available): …
0.2.3.	Family identifiers: …
0.2.3.1.	Monitor family(s): …
0.2.3.2.	Battery Durability family(s): …
0.4.	Category of vehicle (c): …
0.5.	Type of vehicle (PEV or OVC-HEV): …
0.9.	Name and address of the manufacturer's representative (if any): …
1.	GENERAL CONSTRUCTION CHARACTERISTICS
1.1.	Photographs and/or drawings of a representative vehicle/component/separate technical unit (1):
2.	MASSES AND DIMENSIONS (f) (g) (7) (in kg and mm) (Refer to drawing where applicable)
2.6.	Mass in running order (h) (a) maximum and minimum for each variant: …
2.8.	Technically permissible maximum laden mass stated by the manufacturer (i) (3): …
3.	PROPULSION ENERGY CONVERTER (k)
3.1.	Manufacturer of the propulsion energy converter(s): …
3.1.1.	Manufacturer's code (as marked on the propulsion energy converter or other means of identification): …
3.3.	Electric powertrain (for PEV only)
3.3.1.	General description of electric powertrain

3.3.1.1.	Make: .....
3.3.1.2.	Type: .....
3.3.1.3.	Use ([1]): Monomotor/multimotors (number): .....
3.3.1.9.	Maximum power: ..... kW
3.3.2.	Traction REESS
3.3.2.1.	Trade name and mark of the REESS: .....
3.3.2.2.	Kind of electro-chemical couple: .....
3.3.2.3.	Nominal voltage: V
3.3.2.4.	REESS maximum thirty minutes power (constant power discharge): ..... kW
3.3.2.5.	REESS performance in 2 h discharge (constant power or constant current): (1)
3.3.2.5.1.	REESS energy: ..... kWh
3.3.2.5.2.	REESS capacity: ..... Ah in 2 h
3.3.2.5.3.	End of discharge voltage value: V
3.3.2.6.	Indication of the end of the discharge that leads to a compulsory stop of the vehicle: (1) .....
3.3.2.8.	Number of cells:……
3.3.2.10.	Type of coolant : air/liquid ([1])
3.3.2.11.	Battery management system control unit
3.3.2.11.1.	Make: ……..
3.3.2.11.2.	Type: …….
3.3.2.11.3.	Identification number: …..
3.3.3.	Electric Motor
3.3.3.1.	Working principle:
3.3.3.1.1.	direct current/alternating current (1) /number of phases: .....
3.3.3.1.2.	separate excitation/series/compound (1)
3.3.3.1.3.	synchronous/asynchronous (1)
3.3.3.1.4.	coiled rotor/with permanent magnets/with housing (1)
3.3.3.1.5.	number of poles of the motor: .....
3.3.4.	Power controller
3.3.4.1.	Make : .....
3.3.4.2.	Type : .....
3.3.4.2.1.	Identification number: …...

3.3.4.3.	Control principle: vectorial/open loop/closed/other (to be specified): (1) .....
3.3.5.	Cooling system: Motor: liquid/air (1) Controller: liquid/air (1)
3.3.5.1.	Liquid-cooling equipment characteristics:
3.3.5.1.1.	Nature of the liquid ..... circulating pumps: yes/no (1)
3.3.5.1.2.	Characteristics or make(s) and type(s) of the pump: .....
3.3.5.1.3.	Thermostat: setting: .....
3.3.5.1.4.	Radiator: drawing(s) or make(s) and type(s): .....
3.3.5.1.5.	Relief valve: pressure setting: .....
3.3.5.1.6.	Fan: characteristics or make(s) and type(s): .....
3.3.5.1.7.	Fan duct: .....
3.3.5.2.	Air-cooling equipment characteristics
3.3.5.2.1.	Blower: characteristics or make(s) and type(s): .....
3.3.5.2.2.	Standard air ducting: .....
3.3.5.2.3.	Temperature regulating system: yes/no (1)
3.3.5.2.4.	Brief description: .....
3.3.5.2.5.	Air filter: ..... make(s): ..... type(s):
3.3.5.3.	Temperatures admitted by the manufacturer (maximum)
3.3.5.3.1.	Motor outlet: .....° C
3.3.5.3.2.	controller inlet: .....° C
3.3.5.3.3.	at motor reference point(s): .....° C
3.3.5.3.4.	at controller reference point(s): .....° C
3.3.8.	Lubrication system principle: (1) Bearings: friction/ball Lubricant: grease/oil Seal: yes/no Circulation: with/without
3.3.9.	Charger
3.3.9.1.	Charger: on board/external (1) in case of an external unit, define the charger (trademark, model): .....
3.3.9.2.	Description of the normal profile of charge:
3.3.9.3.	Specification of mains:
3.3.9.3.1.	Type of mains: single phase/three phase (1)

3.3.9.3.2.	Voltage: .....
3.3.9.4.	Rest period recommended between the end of the discharge and the start of the charge: .....
3.3.9.5.	Theoretical duration of a complete charge: .....
3.3.10.	Electric energy converters
3.3.10.1.	Electric energy converter between the electric machine and traction REESS
3.3.10.1.1.	Make : .....
3.3.10.1.2.	Type : .....
3.3.10.1.3.	Declared nominal power : ..... W
3.3.10.2.	Electric energy converter between the traction REESS and low voltage power supply
3.3.10.2.1.	Make : .....
3.3.10.2.2.	Type : .....
3.3.10.2.3.	Declared nominal power : ..... W
3.3.10.3.	Electric energy converter between the recharge-plug-in and traction REESS
3.3.10.3.1.	Make : .....
3.3.10.3.2.	Type : .....
3.3.10.3.3.	Declared nominal power : ..... W
3.4.	Combinations of propulsion energy converters
3.4.1.	Hybrid electric vehicle: yes/no ([1])
3.4.2.	Category of hybrid electric vehicle: off-vehicle charging/not off-vehicle charging: ([1])
3.4.3.	Operating mode switch: with/without ([1])
3.4.3.1.	Selectable modes
3.4.3.1.1.	Pure electric: yes/no ([1])
3.4.3.1.2.	Pure fuel consuming: yes/no ([1])
3.4.3.1.3.	Hybrid modes: yes/no ([1]) (if yes, short description): …
3.4.4.	Description of the energy storage device: (REESS, capacitor, flywheel/generator)
3.4.4.1.	Make(s): …
3.4.4.2.	Type(s): …
3.4.4.3.	Identification number: …

3.4.4.4.	Kind of electrochemical couple: …
3.4.4.5.	Energy: … (for REESS: voltage and capacity Ah in 2 h, for capacitor: J, …)
3.4.4.6.	Charger: on board/external/without ([1])
3.4.4.7.	Type of coolant : air/liquid ([1])
3.4.4.8.	Battery management system control unit
3.4.4.8.1.	Make: ……..
3.4.4.8.2.	Type: ….
3.4.4.8.3.	Identification number: ....
3.4.5.	Electric machine (describe each type of electric machine separately)
3.4.5.1.	Make: …
3.4.5.2.	Type: …
3.4.5.3.	Primary use: traction motor/generator ([1])
3.4.5.3.1.	When used as traction motor: single-/multimotors (number) ([1]): …
3.4.5.4.	Maximum power: … kW
3.4.5.5.	Working principle
3.4.5.5.5.1	Direct current/alternating current/number of phases: …
3.4.5.5.2.	Separate excitation/series/compound ([1])
3.4.5.5.3.	Synchronous/asynchronous ([1])
3.4.5.6.	Cooling system: Motor: liquid/air [(1)] Controller: liquid/air [(1)]
3.4.5.6.1.	Liquid-cooling equipment characteristics:
3.4.5.6.1.1.	Nature of the liquid ..... circulating pumps: yes/no (1)
3.4.5.6.1.2.	Characteristics or make(s) and type(s) of the pump: .....
3.4.5.6.1.3.	Thermostat: setting: .....
3.4.5.6.1.4.	Radiator: drawing(s) or make(s) and type(s): .....
3.4.5.6.1.5.	Relief valve: pressure setting: .....
3.4.5.6.1.6.	Fan: characteristics or make(s) and type(s): .....
3.4.5.6.1.7.	Fan duct: .....
3.4.5.6.2.	Air-cooling equipment characteristics
3.4.5.6.2.1.	Blower: characteristics or make(s) and type(s): .....
3.4.5.6.2.2.	Standard air ducting: .....
3.4.5.6.2.3.	Temperature regulating system: yes/no (1)

3.4.5.6.2.4.	Brief description: .....
3.4.5.6.2.5.	Air filter: ..... make(s): ..... type(s):
3.4.5.6.3.	Temperatures admitted by the manufacturer (maximum)
3.4.5.6.3.1.	Motor outlet: .....° C
3.4.5.6.3.2.	controller inlet: .....° C
3.4.5.6.3.3.	at motor reference point(s): .....° C
3.4.5.6.3.4.	at controller reference point(s): .....° C
3.4.6.	Control unit
3.4.6.1.	Make(s): …
3.4.6.2.	Type(s): …
3.4.6.3.	Identification number: …
3.4.7.	Power controller
3.4.7.1.	Make: …
3.4.7.2.	Type: …
3.4.7.3.	Identification number: …
3.4.9.	Manufacturer's recommendation for preconditioning: …
3.4.10.	FCHV: yes/no [1]
3.4.10.1.	Type of Fuel Cell
3.4.10.1.2.	Make: …
3.4.10.1.3.	Type: …
3.4.10.1.4.	Nominal Voltage (V): …
3.4.10.1.5.	Type of coolant: air/liquid [1]
3.4.10.2.	System description (working principle of the fuel cell, drawing, etc.): …
3.4.11.	Electric energy converters
3.4.11.1.	Electric energy converter between the electric machine and traction REESS
3.4.11.1.1.	Make : .....
3.4.11.1.2.	Type : .....
3.4.11.1.3.	Declared nominal power : ..... W
3.4.11.2.	Electric energy converter between the traction REESS and low voltage power supply
3.4.11.2.1.	Make : .....
3.4.11.2.2.	Type : .....
3.4.11.2.3.	Declared nominal power : ..... W

3.4.11.3.	Electric energy converter between the recharge-plug-in and traction REESS
3.4.11.3.1.	Make : .....
3.4.11.3.2.	Type : .....
3.4.11.3.3.	Declared nominal power : ..... W

Explanatory notes

([1]) Delete where not applicable (there are cases where nothing needs to be deleted when more than one entry is applicable).
([2]) Specify the tolerance.
([3]) Please fill in here the upper and lower values for each variant.
([6]) (Reserved)
([7]) Optional equipment that affects the dimensions of the vehicle shall be specified.
([x]) For insulation nominal volume and insulation nominal weight, state to 2 decimal places. A tolerance of +/- 10 per cent shall be applied for insulation volume and insulation weight. Not to be documented if "no" in paragraph 3.2.20.2.5. or 3.2.20.2.7.
([c]) As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.6, paragraph 2. - www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html.
([f]) Where there is one version with a normal cab and another with a sleeper cab, both sets of masses and dimensions are to be stated.
([g]) Standard ISO 612: 1978 — Road vehicles — Dimensions of motor vehicles and towed vehicles — terms and definitions.
([h]) The mass of the driver is assessed at 75 kg.
The liquid containing systems (except those for used water that must remain empty) are filled to 100 % of the capacity specified by the manufacturer.
([i]) For trailers or semi-trailers, and for vehicles coupled with a trailer or a semi-trailer, which exert a significant vertical load on the coupling device or the fifth wheel, this load, divided by standard acceleration of gravity, is included in the maximum technically permissible mass.
([k]) In the case of a vehicle that can run either on petrol, diesel, etc., or also in combination with another fuel, items shall be repeated.
In the case of non-conventional engines and systems, particulars equivalent to those referred to here shall be supplied by the manufacturer.
([l]) This figure shall be rounded off to the nearest tenth of a millimetre.
([m]) This value shall be calculated ($\pi = 3.1416$) and rounded off to the nearest cm^3.
([n]) Determined in accordance with the requirements of UN Regulation No. 85.
([p]) The specified particulars are to be given for any proposed variants.
([q]) With respect to trailers, maximum speed permitted by the manufacturer.