Submitted by F&SC

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Agenda item 9(b)

Resolution XX

Uniform provisions concerning the fast charging performance of light-duty electrified chargeable vehicles using direct current – Fast Charge Power Curve (FCPC)

9 March 2026

Draft text proposal prepared by the F&SC cluster, reflecting the current state of play
Unresolved issues and discussion items are placed in [brackets]

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1. SCOPE

This Resolution applies to Pure Electric Vehicles (PEVs) and Off-vehicle Charging Hybrid Electric Vehicles (OVC-HEVs) of vehicle categories M_1, M_2 and N_1.

2. DEFINITIONS

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

"*Battery preconditioning system*" means a system to condition the battery system prior to the fast-charging event to optimise the charging performance.

"*EV supply equipment*" (EVSE) means the equipment to supply electric energy for fast charging the vehicle's REESS.

"*Fast charging*" means charging the battery of an electric vehicle by an off-board charging system at a DC power reaching at least 50 kW.

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

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

"*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.

"State of Charge" (SOC) means the indicated value of the residual capacity in a battery available to be discharged expressed as a percentage and as indicated to the vehicle operator.

"State of certified energy" (SOCE) means the durability performance of the battery at a specific point in the lifetime of the vehicle, determined as a measured or estimated usable battery energy divided by the certified usable battery energy, and expressed as a percentage.

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

3. ABBREVIATIONS

DC	Direct Current
EVSE	Electric vehicle supply equipment
KPI	Key performance indicator
REESS	Rechargeable electric energy storage system
SOC	State of Charge
SOE	State of Energy
SOCE	State of Certified Energy
UBE	Usable battery (REESS) energy
WLTP	Worldwide harmonised Light vehicles Test Procedure

4. GENERAL REQUIREMENTS

4.1 Family criteria

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

(a) Battery type and model dimensions, construction, type of cell (including format and chemistry), nominal voltage, nominal power, cooling system, capacity, etc.);

(b) Battery management system with regard to DC fast charging, including SOC monitor and the algorithm for estimating the on-board SOC;

(c) Battery passive and active thermal management system (including battery preconditioning system for fast charging);

(d) Charging system design elements having a non-negligible influence on fast charging;

(e) Declared maximum charging power;

(f) Operation strategy of all systems regarding fast charging;

(g) On-board battery data availability (voltage, current, SOC, battery [preconditioning flag], etc.);

(h) Any other characteristics having a non-negligible influence on fast charging.

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.

4.2 Selection of the test vehicle

The test vehicle shall be representative for the vehicle model [for type-approval] in terms of its battery, charging system and other relevant components.

In the case of a vehicle family, a test vehicle shall be chosen from the vehicle family with the expected worst-case fast-charging performance. The manufacturer and the responsible authority shall agree which vehicle test model this shall be, based upon appropriate technical justification. If there are different maximum charging power levels within the vehicle family, the selected test vehicle shall be charged at the lowest charging power level.

5. SPECIFICATIONS AND TESTS

5.1 EVSE specifications and requirements

The manufacturer shall specify the recommended DC charging voltage and maximum DC charging current for the test vehicle.

The EVSE shall be capable of delivering the required DC voltage to the vehicle as specified by the vehicle manufacturer. The EVSE shall be capable of delivering a continuous DC charging current to the vehicle that is the same or higher than the maximum charging current specified by the vehicle manufacturer. These requirements shall be maintained uninterruptedly throughout the fast-charge test phase of the test procedure.

[The EVSE shall be capable to communicate the delivered voltage and current taken from the grid with the same accuracy, resolution and sample frequency as specified for the vehicle in paragraph 5.2.]

Instead of using a standard EVSE, also an EVSE emulator may be used with the same specifications as above.

5.2 Measurement system requirements

The sensors and measurement systems used to determine the fast-charging performance of the vehicle during the fast-charge test procedure as described in Section 6. shall fulfil the following requirements with regard to their accuracy, resolution and sample frequency:

(a) Time (s) shall be measured with an accuracy of ±1 second and a resolution of ≤1 second;

(b) SOC monitor(%)shall be indicated by the vehicle with a sample frequency of 1 Hz and with a resolution of at least 1 part in 100;

(c) Battery voltage (V) shall be measured with an accuracy of ±1% at a sampling frequency of 10 Hz and a resolution of 1 V;

(d) Battery current (A) shall be measured with an accuracy of ±1% at a sampling frequency of 10 Hz and a resolution of 1 A;

(e) Electric energy (kWh) shall be evaluated with an accuracy of ±1%of reading or 0,3% of full scale of measurement, whichever is greater, at a sampling frequency of 10 Hz and a resolution of 1 Wh

(f) Temperature (°C) shall be measured with an accuracy of ±1 °C at a minimum sampling frequency of 0,033 Hz;

(g) Battery preconditioning system indicator (enabled/disabled) at a minimum sampling frequency of 1 Hz.

In the case that battery voltage and/or current are provided from the vehicle's on-board data, the accuracy shall be demonstrated by the manufacturer to the responsible authority in accordance with paragraph 2.2 respectively 3.3 of Appendix 3 to Annex B8 of UN Regulation 154. This demonstration may be omitted if the vehicle has been type-approved according to UN Regulation 154 and this accuracy was already demonstrated and confirmed.

5.3 Test vehicle

The test vehicle and its battery shall be presented in good technical condition. The test vehicle shall have been run-in for a minimum of 300 kilometres or the declared all electric range (AER) for OVC-HEVs respectively the pure electric range (PER) for PEVs, whichever is the higher. The declared AER for OVC-HEVs is determined in paragraph 4.4.1.1. to Annex B8 of UN Regulation 154; the declared pure electric range (PER) is determined in paragraph 4.4.2. to Annex B8 of UN Regulation 154.

For the battery of the test vehicle, the durability parameter State of Certified Energy (SoCE), as determined by UN R154 Annex C1, shall at be 98% or higher.

[The test vehicle shall have an SOC monitor installed which shows the remaining energy in the battery as a percentage of the fully charged battery energy. The vehicle manufacturer shall ensure that the algorithm of the SOC monitor is designed to deliver the most reliable SOC value achievable, taking into account the inherent limitations of the battery system's measurable parameters.]

If a battery preconditioning system is installed, the vehicle manufacturer shall specify how this system can be manually engaged and disengaged by the vehicle user.

The test vehicle shall be able to communicate the following on-board vehicle parameters (e.g. on the OBD port):

- [SOC monitor (%), this shall present the same value as indicated to the vehicle user.]
- Battery current (A);
- Battery voltage (V);
- Battery preconditioning flag (enabled/disabled), if applicable, indicating whether the battery preconditioning system for fast charging is engaged.

If the vehicle is not capable to communicate the battery current and/or voltage it may be instrumented according to the requirements of paragraph 2.1 respectively 3.1 of Appendix 3 to Annex B8 of UN Regulation 154.

If the vehicle is not capable to communicate a flag indicating the status of the battery preconditioning system or if the system cannot be manually operated by the vehicle user, it shall be tested with the battery preconditioning system disengaged.

5.4 [SOC/SOE verification]

[P.M.]

6. FAST-CHARGE TEST PROCEDURE

6.1 General requirements

The fast-charge test procedure consists of the following phases that shall be consecutively executed in this order:

1. Vehicle preparation
2. Soaking

3. Preconditioning

4. Fast-charge testing

The start [SOC/SOE] condition shall be a value of 10%.

The end [SOC/SOE] condition shall be a value 80%.

6.2 Vehicle transfers

In between the phases of the test procedure the vehicle may be transferred to another area. Vehicle transfers shall be undertaken as quickly as possible without undue delay. The maximum transfer time shall be 30 minutes for vehicles which REESS has a UBE of less than or equal to 25 kWh, or 45 minutes for vehicles which REES has a UBE of more than 25 kWh.

During vehicle transfers, the vehicle shall:

a) Not be exposed to temperatures above 30 °C;

b) Not be driven under its own power;

c) Not have the battery preconditioning system engaged;

d) Not be externally charged or discharged nor have any other energy transfer to the battery.

6.3 EVSE preparation

At the option of the manufacturer, the EVSE may be prepared to allow the recording of its operational metrics as specified in paragraph 5.2 during the test, if applicable. The measurement devices shall be installed at suitable and safe position(s) within the EVSE and vehicle. The charging station shall be powered by an external power supply.

6.4 Vehicle preparation

The test vehicle may be prepared according to the manufacturer recommendation. This preparation may include charging and discharging of the battery but shall be limited to one full charge and one full discharge. The manufacturer shall specify a target [SOC/SOE] range to be achieved by the end of the preparation phase, ensuring that the start [SOC/SOE] condition required for the test procedure is met following the soak period and vehicle preconditioning. The area where the vehicle is prepared shall not have a temperature above 30 °C.

6.5 Soaking

Following the vehicle preparation phase, the vehicle shall be soaked for a minimum of 12 hours in a soak area which meets the requirements of paragraph 2.2.2.2. of Annex B6 to UN Regulation 154. The battery preconditioning system shall be disengaged throughout the soaking phase.

At the option of the manufacturer the soaking phase may be omitted if the battery has a pre-warming system engaged during the preconditioning phase and the vehicle is not stored in a room above [23 °C] in the [12 hours] prior to the preconditioning phase. If this option is selected, it shall be noted in the test report.

At the option of the manufacturer the EVSE may be soaked simultaneously to the soak and preconditioning phases of the vehicle in accordance with the EVSE manufacturer's recommendations to stabilise the internal electrical systems.

6.6 Vehicle preconditioning

Following the soaking phase, the vehicle may be preconditioned to bring the battery towards the start [SOC/SOE] condition for the fast-charge testing phase.

The time for preconditioning shall be limited to a maximum of 30 minutes. The area for preconditioning shall fulfil the same requirements as for the soaking area.

During the preconditioning phase the battery preconditioning system may be engaged, if installed.

During the preconditioning phase the vehicle may be driven under its own power [driving cycle to be decided] on a chassis dynamometer to allow the operation of the battery preconditioning system and/or to bring the battery [SOC/SOE] towards the starting condition for the test

6.7 Fast-charge testing

Following the vehicle preconditioning phase, the vehicle the fast-charge test shall be executed.

The area where the fast-charge test takes place shall meet the requirements of paragraph 2.2.2.2. of Annex B6 to UN Regulation 154.

During the entire test the vehicle shall fulfil the following requirements:

- Be in a parked position with the doors closed and without any occupants;
- Be placed in a position with a minimum clearance around the vehicle's outer edges in a horizontal plane of 1 meter;
- Be solely connected to the EVSE, without any other energy transfer to the battery;
- Have its powertrain disengaged and its driving mode selector in the position normally applied for parking;
- Have its battery preconditioning system disengaged (if installed);
- Have any auxiliary systems that can be switched off by the vehicle user disengaged;
- Have any auxiliary system normally activated during charging by control of the vehicle engaged.

The fast-charge test shall commence if the vehicle fulfils the [SOC/SOE] start condition and the above-mentioned requirements are met, but no later than 15 minutes after either the end of the preconditioning phase or, if the preconditioning phase was conducted elsewhere, the vehicle transfer.

During the fast-charge testing phase, all parameters specified in paragraph 5.2 (measurement system requirements) shall be recorded at the indicated accuracy, resolution and measurement sample frequency from the first moment that the vehicle is connected to the EVSE.

The fast-charge test shall end as soon as the end [SOC/SOE] condition has been reached.

7. Data processing and KPIs

7.1 [Calculation of KPIs

After completion of the fast-charge test, the following KPIs shall be determined from the recorded measurement data:

(a) The time in seconds from the first moment that the start [SOC/SOE] condition is reached to the first moment that the end SOC/SOE condition is reached;

(b) Over the time interval determined in (a), the highest maximum charging power averaged over a [30 second] interval;

(c) Over the time interval determined in (a), the average charging power;

(d) Over a time interval of 600 seconds, starting from the first moment that the start SOC/SOE condition is reached, the recharged electric range;]

7.2 Rounding

Intermediate steps in the calculations shall not be rounded unless intermediate rounding is required. Final rounding and units of KPIs are as follows:

- Time-based KPIs are expressed in minutes and rounded to one decimal point;
- Power-based KPIs are expressed in kW and rounded to the nearest whole number;
- Electric range-based KPIs are expressed in km and rounded to the nearest whole number;
- [[SOC/SOE]-based KPIs are expressed as a percentage and rounded to the nearest whole number].

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 12,34 minutes but only one decimal point has to be retained, the final result shall be 12,3 minutes.

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 12,35 minutes but only one decimal point has to be retained, the final result shall be 12,4 minutes

At the option of the manufacturer, KPIs may be declared at a different value than which was calculated by this paragraph, but only towards a worse fast-charging performance.

Example:

If the time interval measured over the SOC interval from 10-80% is 631 seconds and therefore rounded to 10,5 minutes, the associated KPI may be declared at 10,5 minutes or higher.

7.3 Review clause

By 31 December 2029 this set KPIs shall be reviewed by GRPE by evaluating if these match information needs of vehicle users and particularly if a need exists to include KPIs related to the efficiency of the fast charging process.

8. CONFORMITY OF PRODUCTION (optional)

[PM]

9. IN-SERVICE CONFORMITY (optional)

[PM]

ANNEXES

1. Information concerning the conduct of tests

[PM]

2. Communication and test report

[PM]

3. Tests at low and high ambient temperatures (optional)

[PM]