UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
AIR AND RADIATION

October 28, 2016

Dear Electric Vehicle Supply Equipment Brand Owner or Other Interested Party:

The U.S. Environmental Protection Agency (EPA) received constructive suggestions in response to the Draft 2 Electric Vehicle Supply Equpiment (EVSE) specification and would like to engage stakeholders on three relatively modest revisions to the specification and test method before incorporating them into a Final Draft later this fall. The proposed language reflecting these changes to the Specification and Test Method can be found in Appendices A–C, below.

Specification: Energy Efficiency Criteria for No Vehicle Mode

In response to Draft 2, stakeholders relayed that energy efficiency criteria were missing for a mode in which the EVSE is not physically connected to the vehicle but still drawing power. Stakeholders recommended that this mode be defined as 'No Vehicle Mode' to clarify that the EVSE is not physically connected to the vehicle. For completeness in defining all possible modes, EPA had previously defined this mode as 'Off Mode' in Draft 2. EPA proposes replacing the term "Off Mode" with "No-Vehicle Mode", while keeping the same definition, which aligns with interface State A defined in SAE J1772:

No Vehicle Mode: Condition during which the equipment is connected to external power, where the vehicle is not connected and is only providing tertiary function(s). No Vehicle Mode is intended to be the lowest-power mode of the EVSE that can only be entered or exited through manual intervention.

> *Note: The vehicle-EVSE interface is in State A of SAE J1772, where the vehicle is not connected.*

Though EPA did not propose energy efficiency criteria for No Vehicle Mode (then Off Mode) in Draft 2, based on another review of test data assembled, EPA saw that the power consumption for No Vehicle Mode is not always lower than that for Idle Mode. To ensure energy savings, EPA proposes the same base criteria and allowances for No Vehicle Mode as are proposed for both Partial On and Idle Modes, based on an analysis of the data indicating that such levels continue to capture top-performing EVSE models. EPA's proposed criteria for No-Vehicle Mode as they would appear in the specification can be seen in Appendix A.

Test Method: Multi-Port Testing

In response to new suggestions to better account for testing commercial EVSE with multiple ports, EPA proposes a modification to the Final Draft Test Method that specifies which inputs shall be connected to the power supply and power meter and which outputs shall be connected

to the Vehicle Emulation Module (VEM). The proposed language to the Test Method reflecting these changes can be seen in Appendix B and clarifies the following:

- All Modes: All inputs shorted together; requires only one power supply and one power meter.
- No Vehicle Mode: All outputs disconnected. Input power measured once and divided by the number of outputs to make the results comparable to those of a single-output EVSE.
- Partial On Mode: All outputs connected to VEMs. Input power measured once and divided by the number of outputs.
- On Mode, Idle Mode: All outputs connected to VEMs and switched to State C simultaneously. The input power is measured once for all outputs and the results are divided by the number of outputs. Any overhead power shared between the outputs will be divided by the number of outputs, so the resultant power draw may be lower than when not all the outputs are used simultaneously.
- On Mode, Operation Mode: All outputs connected to VEMs. Outputs are switched to State C sequentially. The input power is measured for each output and the results added together. To limit double-counting power draw common to all outputs, the previously measured Partial On Mode power shall be multiplied by (n-1), where n is the number of outputs, and subtracted from the above result. The available current shall be the maximum current that can be provided by the unit when a single output is being used. The unit shall be configured to provide this maximum current during initial set-up.[1] This process is illustrated in Figure 1 in Appendix B.
- Results will be divided by the number of outputs such that they will be comparable to single-output EVSE, allowing for the same requirements to be applicable to single- and multiple-output EVSEs. Moreover, this will provide an incentive for multiple-output EVSEs to share functionality across outputs.
- Finally, the above requirements seek to minimize test burden by requiring no additional power meters compared to the single-output test. The only additional piece of test equipment would be one or more VEMs, which should be a low-cost item to procure or manufacture.

Test Method: Display Brightness Testing

Finally, EPA proposes additional guidance on how to set up and measure display brightness for models claiming the display allowance, as seen in Appendix C. Specifically, EPA proposes to:

[1] Some EVSE outputs may provide less than this maximum current when multiple outputs are in use (i.e., the outputs are forced to share the available current). However, this condition should be represented by the 15 A and 4 A tests in the test method, so EPA is not proposing an additional lower-maximum-current test.

- Clarify that models that cannot display the IEC three-bar pattern have their luminance (screen brightness) tested using the default image that appears as-shipped. In contrast to standalone Displays and Televisions;, EPA expects that not all EVSEs will be able to display standard test patterns.

- Clarify that models that ship without ABC enabled by default be adjusted to 65% of maximum brightness during the test (which is the brightness that was used when developing the allowance) to within the tolerances of the adjustments available on the EVSE (e.g., if the EVSE provides settings resulting in 50% and 75% of maximum brightness, choose the 75% setting).
- Clarify that the power testing be conducted with the default image that appears as-shipped. EPA welcomes feedback on whether this will provide enough repeatability or whether a standards test clip or test pattern should be specified for those models that can support it in order toimprove representativeness.

Stakeholder Feedback

We value your participation the development of this specification. EPA will be hosting a **webinar on Monday, November 7, 2016 from 1–4 pm Eastern Time** to gather stakeholder feedback to the proposed additions and modifications to the specification. Please register for the webinar here. Please provide any written feedback no later than **November 16, 2016** to ElectricVehicleSupplyEquipment@energystar.gov. If you have any questions about the ENERGY STAR program and this effort in particular, please contact me at Verena Radulovic, EPA, at Radulovic.Verena@epa.gov and (202) 343-9845 or Matt Malinowski, ICF International, at Matt.Malinowski@icf.com and (202) 862-2693.

Thank you for your support of ENERGY STAR. I look forward to continuing to work with you in developing this specification for EVSE.

Sincerely,

Verena Radulovic, Product Manager
ENERGY STAR for Electric Vehicle Supply Equipment

APPENDIX A: NO VEHICLE MODE CRITERIA

Changes to the Specification as a result of the outlined proposals:

3.2 No Vehicle Mode Requirements

Note: These requirements refer to the SAE J1772 State A.

3.2.1 Measured No Vehicle Mode power ($P_{NO\_VEHICLE}$) shall be less than or equal to the Maximum No Vehicle Mode Power Requirement ($P_{NO\_VEHICLE\_MAX}$), as calculated per Equation 1.

i. For products with ABC enabled by default, the average No Vehicle Mode power in high and low illuminance conditions shall be used in place of $P_{NO\_VEHICLE}$, above.

Equation 1: Calculation of Maximum Partial On Mode Power Requirement

$$P_{NO\_VEHICLE\_MAX} = P_{NO\_VEHICLE\_BASE} + \sum_{i=1}^{n} P_{WAKE\_i}$$

Where:

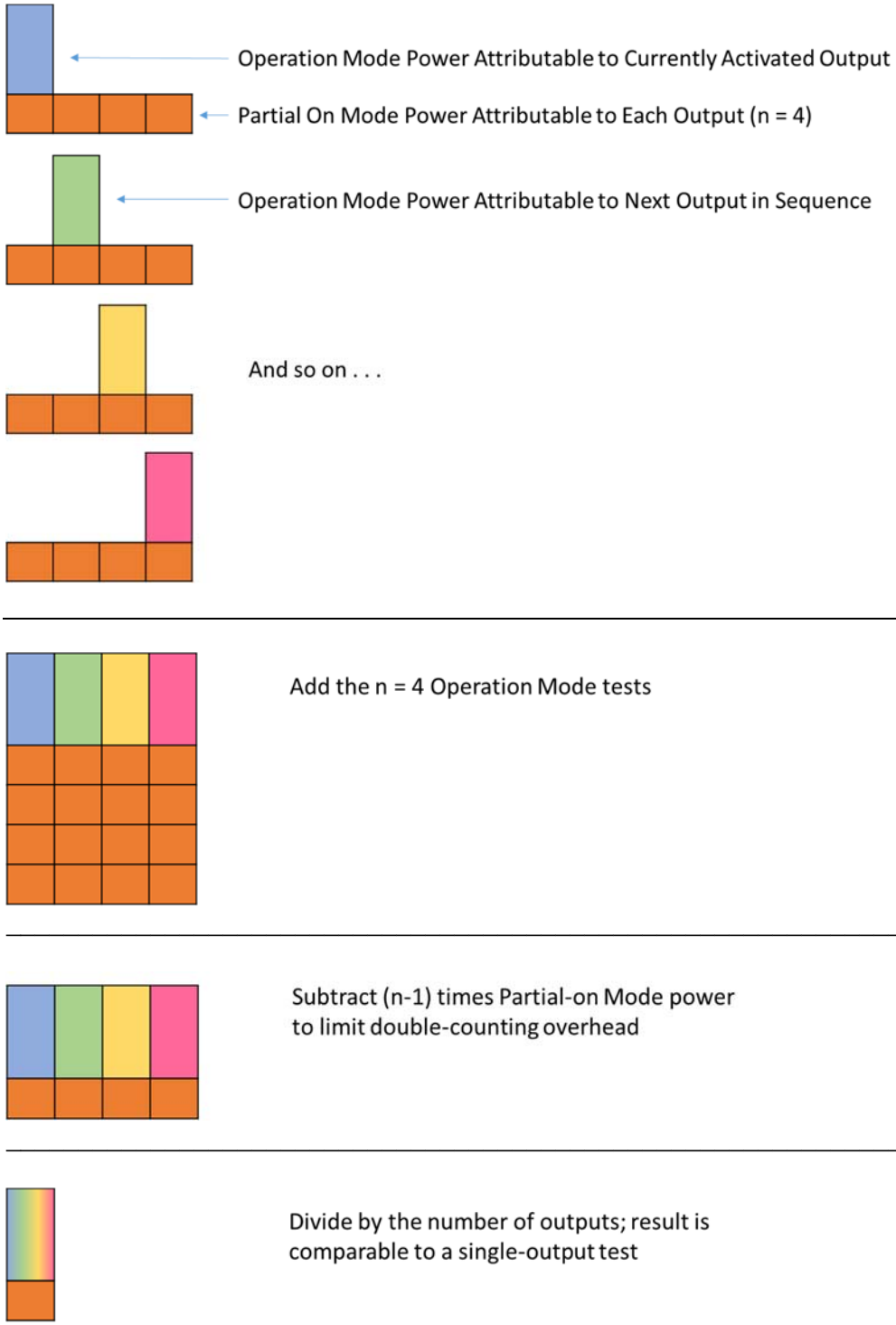
- $P_{NO\_VEHICLE\_MAX}$ *is the Maximum No Vehicle Mode Power Requirement;*
- $P_{NO\_VEHICLE\_BASE}$ *is the base No Vehicle Mode power allowance for all products, as specified in Table 2;*
- P_{WAKE_i} *is the No Vehicle Mode power allowance for each active, in-use networking/control protocol that provides remote hosts with the capability to wake the product from No Vehicle Mode, as specified in Table 2, for a total of n such allowances.*

Table 2: No Vehicle Mode Power Allowances

Product Function	No Vehicle Mode Power Allowance (watts)
Base Allowance for All Products ($P_{NO\_VEHICLE\_BASE}$)	2.6
In-use Wi-Fi or Ethernet Interface with Wake Capability *(P_{WAKE_i})*	1.0
In-use Cellular with Wake Capability *(P_{WAKE_i})*	2.0
Other In-use LAN (Local Area Network) Interface with Wake Capability *(P_{WAKE_i})*	1.0
In-use Display (*P_{WAKE_i}*)	$(4.0 \times 10^{-5} \times \ell \times A) + 119 \times \tanh(0.0008 \times [A - 200.0] + 0.11) + 6.0$ *Where:* • *A* is the Screen Area in square inches; • ℓ is the Maximum Measured Luminance of the Display in candelas per square meter, as measured in Section 4) C) of the ENERGY STAR Test Method for Determining Electric Vehicle Supply Equipment Energy; • *tanh* is the hyperbolic tangent function; and The result shall be rounded to the nearest tenth of a watt for reporting.

APPENDIX B: MULTI-PORT TESTING

Figure 1: Illustration of Multi-port Testing in Operation Mode (Not to Appear in the Test Method)



Changes to the Test Method that reflect the proposals for multi-port testing:

5.2 No Vehicle Mode (State A) Testing

A) No Vehicle Mode testing shall be conducted for all products.

B) Conduct the UUT preparation procedure in Section **Error! Reference source not found.**

C) Verify the UUT output connector is unplugged from VEM.

D) Measure and record UUT input power.

1) For single-output EVSEs: $P = I_{diff1} \times V_{in}$

2) For multiple-output EVSEs: $P = \frac{I_{diff1} \times V_{in}}{n}$, where *n* is the number of outputs.

E) Power shall be measured according to IEC 62301 Ed 2.0-2011; with the additional guidance in Section 4 of this document.

5.3 Partial On Mode (State B) and Idle Mode (State C) Testing

…

D) Conduct the following procedure to measure the UUT power consumption:

1) State C[2]: Plug in all UUT output connection(s) to J1772 vehicle inlet on a corresponding number of VEM(s). Switch all VEMs to State C by closing switch S1. Measure and record:

a) For single-output EVSEs:

i. UUT input power; $P = I_{diff1} \times V_{in}$

ii. UUT output RMS current I_{out2} (to verify zero output current).

b) For multiple-output EVSEs,

i. UUT input power; $P = \frac{I_{diff1} \times V_{in}}{n}$, where *n* is the number of outputs

ii. UUT output RMS current I_{out2} (to verify zero output current)

2) State B: Plug in the UUT output connection to J1772 vehicle inlet on the VEM. Connect all output cords to a corresponding number of VEMs. Verify S1 is open. Wait 2 minutes and then measure and record UUT input power:

a) For single-output EVSEs: $P = I_{diff1} \times V_{in}$

b) For multiple-output EVSEs: $P = \frac{I_{diff1} \times V_{in}}{n}$, where n is the number of outputs.

E) Power shall be measured according to IEC 62301 Ed 2.0-2011; with the additional guidance in Section 4 of this document.

[2] This state represents a vehicle connected and ready to accept current.

5.4 Operation Mode (State C) Testing[3]

A) …

B) …

C) Determine the UUT available current.

1) Conduct the UUT preparation procedure in Section 5.1.

2) For multiple-output EVSEs, the available current shall be the maximum current that can be provided by the unit when a single output is being used (i.e., no derating/current sharing). The unit shall be configured to provide this maximum current.

3) State C: Plug in the UUT output connection to J1772 vehicle inlet on VEM. Connect all output cords to a corresponding number of VEMs. If the UUT has multiple output cords, the outputs will be switched to State C sequentially. Close S1 in the VEM; for a multiple-output EVSE, switch that VEM to State C by closing switch S1, while keeping the remainder in State B (S1 open).

D) Warm-up …

E) Measurement

1) ...

2) The following measurements and calculated values shall be recorded after the 5-minute stabilization period:

…

i) For multiple-output EVSEs, Total Power Loss calculated as follows:

i. Measure power loss for each output (sum of the power loss measurements 5.5.E.2.e, f, and g), where i is the number of the output under test:

$$P_{loss_i} = I_{diff1_i} \times V_{in} + I_{in1} \times V_{diff1_i} - I_{out2_i} \times V_{diff2_i}$$

ii. Switch the VEM under test back to State B by closing S1.

iii. Connect the output power meter to the next VEM. And close S1 on the VEM putting it in State C.

iv. Repeat steps i through iii, above, until the power loss from each output has been measured.

v. Sum the power measurements for each output and divide by the number of outputs, *n*.

vi. After conducting the Partial On test, above, multiply the measured Partial On power by *n*-1 and subtract from the resulting power calculated above as shown below:

$$P_{loss} = \frac{\sum_{i=1}^{n} P_{loss_i}}{n} - \left(I_{diff1} \times V_{in}\right)(n-1)$$

3) …

4) …

[3] This state is similar to Charging and Maintenance Modes in SAE J2894-2; however, there may be some discrepancies due to network configuration, the lack of a connected battery, and discrete number of power values tested.

APPENDIX C: DISPLAY BRIGHTNESS TESTING

EPA proposes the following additions to the Test Method for testing display brightness. The following sections are additions to the Final Draft Test Method after Section 4.1.B) UUT Configuration and Control. As a result, some existing sections will have a new letter associated with them but their content will be unchanged, as indicated by the ellipsis (…) symbol between section headings.

4 TEST CONDUCT

4.1 Guidance for Implementation of the EVSE Test Procedure

A) As-shipped Condition …

B) UUT Configuration and Control …

C) Luminance Testing for Products with a Display: Luminance testing shall be performed for all products at 100% of screen brightness possible as measured in Section 6.2 of the ENERGY STAR Test Method for Determining Display Energy (Rev. Sep-2015).

1) If the UUT cannot display the three-bar pattern specified in IEC 62087:2011, Section 11.5.5, the UUT shall be tested using the default image that appears as-shipped.

D) Display Brightness for Products without Automatic Brightness Control (ABC) enabled as-shipped: If the UUT has a display the brightness of which is controllable by the user and does not have ABC enabled as-shipped:

1) The display shall be adjusted to 65% of the maximum brightness available on the display during all testing, or a setting available that is closest to 65%, to within the tolerance of the adjustments available on the EVSE (e.g., if the EVSE provides settings resulting in 50% and 75% of maximum brightness, choose the 75% setting).
2) Following this initial set-up, power testing shall be conducted with the default image that appears as-shipped.

E) ~~C)~~ Room Illuminance Conditions for Products with ABC Enabled by Default …

F) ~~D)~~ Test Conditions for Products with an Occupancy Sensors Enabled by Default …

G) Luminance Meters for Products with a Display:

1) Luminance measurement shall be performed using either
   a) A contact meter; or
   b) A non-contact meter.
2) All luminance and illuminance meters shall be accurate to ± 2% (± 2 digits) of the digitally displayed value.
3) Non-contact luminance meters shall have an acceptance angle of 3 degrees or less.

The overall accuracy of a meter is found by taking (±) the absolute sum of 2% of the measurement and a 2 digit tolerance of the displayed value least significant digit. For example, if an illuminance meter displays “200.0” when measuring a screen brightness of 200 cd/m^2, 2% of 200 cd/m^2 is 4.0 cd/m^2. The least significant digit is 0.1 cd/m^2. “Two digits” implies 0.2 cd/m^2. Thus, the displayed value would be 200 ± 4.2 cd/m^2 (4 cd/m^2 + 0.2 cd/m^2).The accuracy is specific to the illuminance meter and shall not be considered as tolerance during actual light measurements.

H) ~~E)~~ Measurement Accuracy for All Products:

1) …

2) …

3) All ambient light values (measured lux) shall be measured at the location of the ABC sensor and showing the default image that appears as-shipped.

4) Ambient light values shall be measured within the following tolerances:

a) At 10 lux, ambient lighting shall be within ± 1.0 lux; and

b) At 300 lux, ambient lighting shall be within ± 9.0 lux.