ENERGY STAR® Program Requirements
Product Specification for
Electric Vehicle Supply Equipment

Draft 2 Test Method
Rev. Oct-2015

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1 OVERVIEW

The following test method shall be used for determining product compliance with requirements in the ENERGY STAR Eligibility Criteria for Electric Vehicle Supply Equipment.

2 APPLICABILITY

ENERGY STAR test requirements are dependent upon the feature set of the product under evaluation. The following guidelines shall be used to determine the applicability of each section of this document:

- The test procedures in Sections 7.1, 7.3, 7.4, and 7.5 shall be performed on all products.
- The test procedures in Section 7.2 shall be performed on products that have an APD timer.
- The test procedures in Section 7.6 shall be performed on products with network connectivity.
- The test procedures in Section 7.7 shall be performed on products with utility grid communication.

3 DEFINITIONS

Unless otherwise specified, all terms used in this document are consistent with the definitions in the ENERGY STAR Eligibility Criteria for Electric Vehicle Supply Equipment, Version 1.0.

Note: The below section lists the definitions that EPA is considering using throughout the EVSE program. This section will eventually be moved to the specification/Eligibility Criteria document, but is included temporarily in this draft test method for ease of reference and to ensure that all aspects of the test method are defined appropriately.

A) Electric Vehicle Supply Equipment (EVSE): The conductors, including the ungrounded, grounded, and equipment grounding conductors, the electric vehicle connectors, attachment plugs, and all other fittings, devices, power outlets, or apparatuses installed specifically for the purpose of delivering energy from the premises wiring to the electric vehicle. Charging cords with NEMA 5-15P and NEMA 5-20P attachment plugs are considered EVSEs. Excludes conductors, connectors, and fittings that are part of the vehicle.[1]

1) Level 1: A galvanically-connected EVSE with a single-phase input voltage nominally 120 volts AC and maximum output current less than or equal to 16 amperes AC.[2]

[1] SAE J2894-1 Section 3.10.

[2] This definition is intended to be consistent with the requirements in SAE J1772, with some additional clarifications.

2) Level 2: A galvanically-connected EVSE with a single-phase input voltage range from 208 to 240 volts AC and maximum output current less than or equal to 80 amperes AC.[2]

Note: EPA would like to receive feedback from stakeholders on EVSE intended for residential versus commercial applications. Specifically, EPA is interested in learning if any features or functions significantly change the energy consumption of the EVSE if used in a residential versus a commercial setting.

3) Fast DC: A galvanically-connected EVSE that includes an off-board charger and provides DC current greater than or equal to 80 amperes DC.

4) Wireless / Inductive: A non-galvanically-connected EVSE.

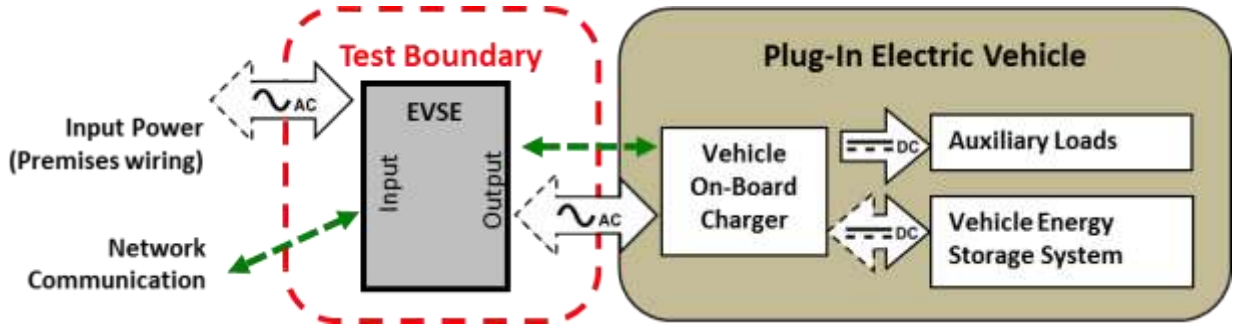
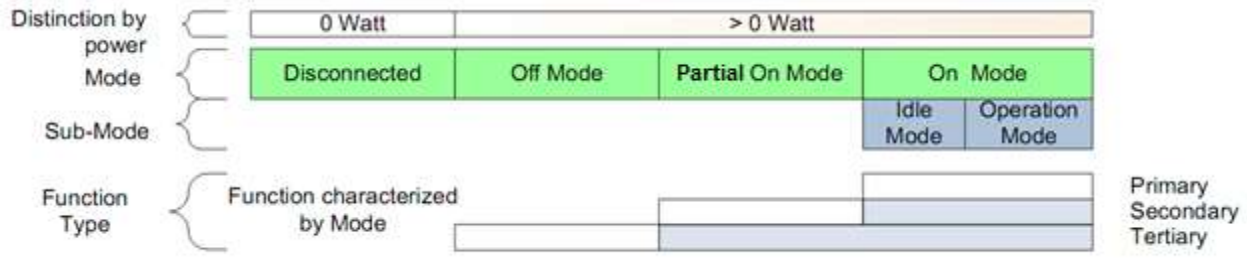


Figure 1: Schematic of Overall Plug-In Vehicle Charging System detailing EVSE Test Boundary

Note: One stakeholder provided feedback that the efficiency of charging with Level 1 EVSE may be lower than Level 2, even if the Level 1 EVSE is efficient in itself. This is due to lower efficiency of the car's battery charger at lower voltages and the longer duration of the charge, which increases the losses of ancillary loads such as air conditioning. EPA continues to propose that the test boundaries for the EVSE exclude the vehicle's on-board charger to only reflect the amount of power that the EVSE draws. However, EPA seeks additional feedback on the differences between Level 1 and Level 2 on-board chargers and the overall impact on efficiency.

In response to mixed stakeholder feedback on the inclusion of reverse power flows, EPA proposes to retain the option to account for reverse power flows in this test method, given the rapidly evolving EVSE technologies. Based on trends in vehicle electrification, EPA anticipates that such functionality may become more commonplace and thus seeks to develop a test method that can account for such functionalities when measuring power consumption.

Note: The below definitions incorporate standard operational mode names, based on IEC 62542 – Environmental Standardization for Electrical and Electronic Products and Systems. This standard establishes mode "classes" that can be applied to a specific product by defining functions as Primary, Secondary, and Tertiary. Using the same mode names (On, Partial On, Off, and Disconnected) across all products reduces ambiguity and allows for cross-comparisons. The modes and the functions available in each are illustrated in the Figure below:



Note: In response to stakeholder requests for better harmonization of definitions with existing industry test methods, EPA has provided footnotes referring to definitions in industry standards where appropriate, but has retained the previously proposed functions and function categories.

EPA notes that any definition of a mode will be incomplete and that the mode will be fully specified only through the test setup and test conduct instructions in the body of the test method. Since these specific instructions will be different than those in other industry standards, EPA considers it less confusing to use the more general function categories rather than existing definitions.

B) EVSE Functions:

1) Primary Function: Function providing the intended purpose. For EVSE, Primary Functions are:

a) Providing current to a connected load.

Note: One group of stakeholders commented that the list of Primary Functions in Draft 1 was incomplete. Rather than listing additional primary functions that rely on the behavior of the connected electric vehicle, EPA has revised the primary function definition to state that the primary function of an EVSE is supplying current, regardless of how that current is used within the vehicle.

2) Secondary Function: Function that enables, supplements or enhances a primary function. For EVSE, Secondary Functions are:

a) Automatic Brightness Control (ABC): The self-acting mechanism that controls the brightness of a display or lamp as a function of ambient light

b) Full Network Connectivity: The ability of the EVSE to maintain network presence while in Partial On mode. Presence of the EVSE's network services, its applications, and possibly its display is maintained even if some components of the EVSE are powered down. The EVSE can elect to change power states based on receipt of network data from remote network devices, but should otherwise stay in a low power mode absent a demand for services from a remote network device.

Note: Full Network Connectivity is not limited to a specific set of protocols. Also referred to as "network proxy" functionality and described in the Ecma-393 standard.

c) Occupancy Sensing: detection of human presence in front of or in the area surrounding an EVSE.

d) Communicating with the vehicle;

e) Illumination of display, indicator lights, or ambient lighting;

f) Public access control (RFID card, authorization, etc.);

g) Safety Functions;

h) Control Pilot Signal

i) Wake-up function.

3) Tertiary Function: Function other than a primary or a secondary function.

Example: An EMC filter, status indication, and area lighting if present, provides their function in off mode, partial on mode and on mode.

C) EVSE Modes:

Note: The transition period to a different mode; whether automatically initiated, or via user action; does not constitute a mode.

1) Disconnected: Condition of the equipment during which all connections to power sources supplying the equipment are removed or galvanically isolated and no functions depending on those power sources are provided.

Note: The term power source includes power sources external and internal to the equipment.

2) Off Mode: Condition during which the equipment is connected to external power and is only providing tertiary function(s).

Note: Off Mode is intended to be the lowest-power mode of the EVSE that can only be entered or exited through a manual switch. Not all devices will have an Off Mode.

3) On Mode: Condition during which the equipment provides at least one primary function or can promptly provide a primary function

a) Operation Mode or State C[3]: Condition during which the equipment is performing at least one primary function.

b) Idle Mode or State B2 or C[3]: Condition during which the equipment can promptly provide a primary function but is not doing so.

Note: Idle mode is the condition within On Mode where the EVSE is connected to the vehicle or vehicle simulator but is not actively charging.

4) Partial On Mode or States A or B1[3]: Condition during which the equipment provides at least one secondary function but no primary function.

5) Power Management: Automatic control mechanism that achieves the smallest power consistent with a pre-determined level of functionality.

D) Other:

1) Average power (P) (also real power): The power in a circuit which is transformed from electric to non-electric energy and is measured in watts (W). For a two-terminal device with instantaneous current and voltage waveforms i(t) and v(t) which are periodic with period T, the real or average power P is[4]:

$$P = \frac{1}{T}\int_0^T v(t)i(t)dt$$

Note: EPA has removed the power factor and apparent power definitions from the test method, as power factor is expected to be close to unity in On Mode, while even a low Power Factor in Partial On Mode is unlikely to have a large impact on losses due to low power levels.

2) Unit Under Test (UUT): The specific sample of a representative model undergoing measurement which includes the base product and any accessories packaged with it.

[3] This mode is intended is typically associated with a vehicle/EVSE interface state (A, B, or C) as defined in SAE J1772, however, it may not always align as these modes refer to the entire EVSE (including networking and other functions), while the SAE J1772 states apply only to the interface.

[4] Average power is intended to align with the definition of real power in SAE J2894

3) Illuminance: means the luminous flux per unit area of light illuminating a given surface, expressed in units of lux.

E) Acronyms:

1) °C: Degree Centigrade
2) A: Ampere
3) AC: Alternating Current
4) DC: Direct Current
5) DOE: U.S. Department of Energy
6) EPA: Environmental Protection Agency
7) EVSE: Electric Vehicle Supply Equipment
8) Hz: Hertz
9) IEC: International Electrotechnical Commission
10) IEEE: Institute of Electrical and Electronics Engineers
11) IPMA: Input Power Measurement Apparatus
12) lx: lux
13) NEMA: National Electrical Manufacturers Association
14) SAE: Society of Automotive Engineers
15) UUT: Unit Under Test
16) V: Volt
17) VEM: Vehicle Emulator Module
18) W: Watts

4 SCOPE

Note: The below section lists the types of products that EPA is considering including within the scope of the EVSE program. This section will eventually be moved to the specification/Eligibility Criteria document, but is included temporarily in this draft test method for ease of reference and to ensure that all the requirements of the test method apply to these specific products.

4.1 Included Products

4.1.1 Level 1 EVSE.

4.1.2 Level 2 EVSE.

4.1.3 Level 1/Level 2 EVSE

Note: EPA has clarified the list of included products to reflect that some EVSE support both Level 1 and Level 2 charging. The testing instructions for these products are included in Section 5.B)2) of this test method.

The presence of an SAE J1772 coupler has been removed from the list of criteria for inclusion in the scope. However, EPA has included instructions in Section 5.G)1)b) that EVSE without a coupler be tested with an adapter, to be provided by the manufacturer, as the SAE J1772 physical interface is the industry standard.

4.2 Excluded Products

4.2.1 Products that are covered under other ENERGY STAR product specifications are currently not eligible for qualification under this specification. The list of specifications currently in effect can be found at www.energystar.gov/specifications.

4.2.2 DC EVSE.

Note: As the energy impacts of AC EVSE are expected to be greater, EPA will consider DC fast and slow chargers in future versions of the EVSE specification.

4.2.3 Wireless/Inductive EVSE.

4.2.4 Power electronic components inside the vehicle.

5 TEST SETUP

A) Test Setup and Instrumentation: Test setup shall be in accordance with the diagram in Figure 2, with additional requirements specified below. All required industry safety tests should be performed prior to the following test to ensure quality and safety.

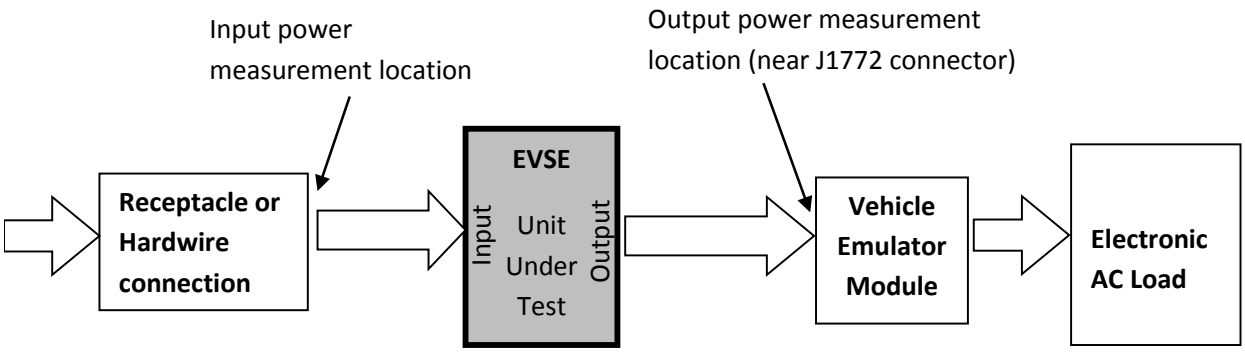


Figure 2: Schematic of test setup connection

B) AC -input Power: The UUT shall be operated at the first (highest) rated voltage and rated frequency combination specified in Table 1.

1) UUTs that are not compatible with any of the combinations listed in Table 1 shall be connected to the highest rated voltage and frequency combination.

2) UUTs that are designed to operate at multiple voltage ranges (both Level 1 and Level 2 functionality) shall be separately tested for both Level 1 and Level 2 operation. In each test configuration, the UUT shall be operated at the first (highest) rated voltage and rated frequency combination specified in Table 1.

3) The voltage and frequency tolerance shall be as specified in Table 2.

Table 1: Input Supply Requirements

Voltage	Frequency
240 V AC	60 Hz
208 V AC	60 Hz
120 V AC	60 Hz

Table 2: Input Power Tolerances

Voltage Tolerance	Maximum Total Harmonic Distortion	Frequency Tolerance
+/- 4.0 %	5.0 %	+/- 1.0 %

C) Input Power Measurement:

1) For EVSE equipped with an input plug and cord, the corresponding receptacle will be used to provide power to the input plug of the EVSE.

   a) Voltage Measurement shall be measured at the wiring terminals of the receptacle providing power to the EVSE input plug.

   b) Current Measurement shall be measured on the wiring connected to receptacle terminals.

2) For EVSE intended for hardwire connection, the EVSE input terminals will be hardwire connected as specified by the EVSE manufacturers installation specifications.

   a) Voltage Measurement shall be measured at the hardwire connection location at the input terminal of the EVSE.

   b) Current Measurement shall be measured on the wiring to the EVSE hardwire connection.

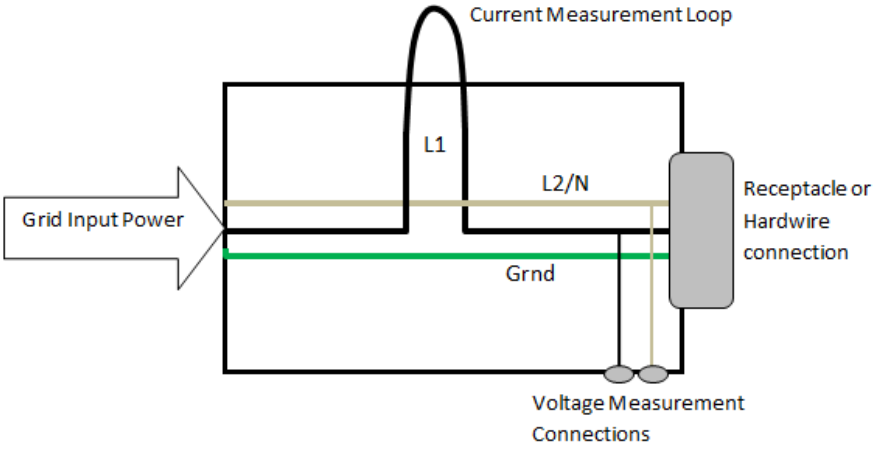


Figure 3: Schematic of Input Power Measurement Apparatus (IPMA)[5]

D) Ambient Temperature: Ambient temperature shall remain at 25°C ± 5°C for the duration of the test.

E) Relative Humidity: Relative humidity shall remain between 10% and 80% for the duration of the test.

F) Cables: All power cables for the test shall be the default provided by the manufacturer

1) If no default EVSE input cable is provided, the input voltage measurement shall be connected directly UUT's input power connection (e.g., screw terminals).

Note: EPA has revised the input power measurement conditions in the case of no default input cables (i.e., hardwired connection). Rather than specify a uniform cable for test, EPA is now proposing that measurements be performed directly at the UUT input terminal, which will reduce testing variability and be more representative of typical installations.

2) For hardwired connections, the input power shall then be connected to the premises wiring with cables and optional connectors that are rated for the voltage and current levels that will be encountered during testing.

G) Test Load: A test load consisting of an AC load bank shall be connected to the EVSE output in lieu of a vehicle.

1) Vehicle Emulator Module (VEM): A VEM allows current and voltage measurements of the UUT output without modifying or altering the UUT output cable. Figure 4 shows an example schematic of the VEM.

a) Output Power measurement: Insulated current conductor loops or current measurement shunts as well as voltage measurement connections are used for the purpose of measurement of the UUT output current and voltage.

b) Output Coupler: The SAE J1772 interface shall be used to connect between the UUT and VEM. If the UUT does not have an SAE J1772 output coupler, an adapter shall be provided by the manufacturer.

c) S1 is a switch which is used to enable control pilot state "C".

[5] In a four-conductor system, the conductor labeled L2/N will actually be two separate conductors: L2 and N.

d) S2 is a switch which is used to enable control pilot state “D”.

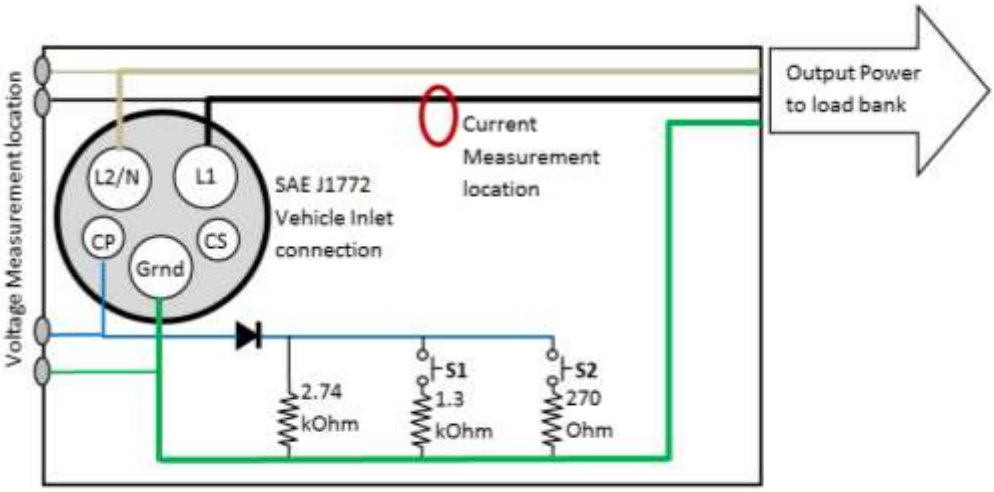


Figure 4: Schematic of Vehicle Emulator Module (VEM)[6]

2) AC Load: The AC load bank shall possess the following capabilities

a) Sink AC current up to the rated RMS current of the UUT;

b) Voltage range within the Level of the UUT (Level 1 or Level 2); and

c) Controllable RMS current levels capable of achieving current levels detailed in Table 4.

H) Power Meter: Power meters shall possess the following attributes:

1) Number of Channels:

a) One channel shall be set up to measure AC power into the UUT;

b) One channel shall be set up to measure AC power output of the UUT; and

2) Crest Factor:

a) An available current crest factor of 3 or more at its rated range value; and

b) Lower bound on the current range of 10 mA or less.

3) Minimum Frequency Response: 3.0 kHz

4) Minimum Resolution:

[6] In a four-conductor system, the conductor labeled L2/N will actually be two separate conductors: L2 and N.

a) 0.01 W for measurement values less than 10 W;

b) 0.1 W for measurement values from 10 W to 100 W; and

c) 1.0 W for measurement values greater than 100 W.

5) Accuracy: +/- 0.1% of reading PLUS +/- 0.1% of full scale

6) Measurements and Calculations:

a) Voltage (RMS);

b) Current (RMS);

c) Average Power (W); and

Note: EPA has removed the power factor, and apparent power, and THD measurements from the test method.

d) Frequency (Hz).

l) Illuminance Meter Accuracy:

1) All luminance and illuminance meters shall be accurate to ± 2% (± 2 digits) of the digitally displayed value.

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 a meter displays "200.0" when measuring an illuminance of 200 lx, 2% of 200 lx is 4.0 lx. The least significant digit is 0.1 lx. "Two digits" implies 0.2 lx. Thus, the displayed value would be 200 ± 4.2 lx (4 lx + 0.2 lx). The accuracy is specific to the illuminance meter and shall not be considered as tolerance during actual light measurements. Light measurements shall be within the tolerance specified in 6.1.C)3).

Note: EPA has added light meter accuracy requirements to support the more robust Test Conduct for products with Automatic Brightness Control (ABC) enabled by default in Section 6.1.C)3)

6 TEST CONDUCT

6.1 Guidance for Implementation of the EVSE Test Procedure

A) As-shipped Condition: Unless specified otherwise, the model unit shall be tested in its default configuration as-shipped.

1) The UUT shall be mounted per the manufacturer's installation instructions. If no manufacturer instructions are provided, the UUT should be tested on a thermally non-conductive surface.

Note: EPA has clarified the set-up instructions to state that the UUT shall be tested per the manufacturer's installation instructions. If no manufacturer instructions are provided, the UUT shall be tested on a thermally non-conductive surface.

B) UUT Configuration and Control:

1) Network Connection Capabilities:

a) Verify the UUT has network connection capabilities:

i. Network connections should be listed in the user manual or installation instructions.

ii. If no connections are specified, verify that the EVSE does not have network capabilities by checking for the absence of physical connections or the absence of network settings in the menu.

2) Peripherals and Network Connections:

a) Any peripherals shipped with the UUT shall be connected to their respective ports per manufacturer instructions. No other devices or accessories shall be connected to any remaining open ports.

b) If the UUT has network connection capabilities, the capabilities shall be activated using any standard or optional hardware provided by the manufacturer, and the UUT shall be connected to a live physical network (including wireless Radio Frequency (RF)).

a. The network shall support the highest and lowest data speeds of the UUT's network function.

b. An active connection is defined as a live physical connection over the physical layer of the networking protocol.

c. If the UUT is equipped with multiple network capabilities, only one connection shall be made in the following order of preference:

i. Wi-Fi (Institution of Electrical and Electronics Engineers - IEEE 802.11- 2007[7]);

ii. Ethernet (IEEE 802.3). If the UUT supports Energy Efficient Ethernet Defined in Clause 78 of IEEE 802.3 (originally specified in IEEE 802.3az)[8], then it shall be connected to a device that also supports IEEE 802.3az;

iii. Cellular modem; or

iv. Other.

c) The tester shall configure the address layer of the protocol, taking note of the following:

i. Internet Protocol (IP) IP v6 has Neighbor Discovery and will generally configure a limited, non-routable connection automatically.

ii. IP can be configured manually or using Dynamic Host Configuration Protocol (DHCP) with an address in the 192.168.1.x Network Address Translation (NAT) address space if the UUT does not behave normally when autoIP is used. The network shall be configured to support the NAT address space and/or autoIP.

d) The UUT shall maintain this live connection to the network for the duration of testing, disregarding any brief lapses, (e.g., when transitioning between link speeds).

e) Ensure there is a connection to the Wide Area Network if required in the manufacturer's instructions.

f) If the UUT needs to install any software updates, wait until these updates have occurred; otherwise, if it will operate without updates, skip these updates.

g) In the case of a UUT that has no data/network capabilities, the UUT shall be tested as-shipped.

[7] IEEE 802 – Telecommunications and information exchange between systems – Local and metropolitan area networks – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications

[8] IEEE 802 – Telecommunications and information exchange between systems – Local and metropolitan area networks – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

C) Room Illuminance Conditions for Products with Automatic Brightness Control (ABC) Enabled by Default: All products with ABC enabled by default shall be tested in two illuminance conditions—light and dark—to simulate daytime and nighttime conditions:

Note: EPA has expanded the requirements in this section to apply to EVSE that have any functions controlled by ABC. Previously, EPA had proposed a low-illuminance ABC test that would recognize the benefits of automatically dimming displays and indicator lamps at night. However, due to stakeholder feedback on the significance of advertising and area lighting—which would be brighter at night but may be turned off during the day—EPA is now proposing a broader test that:

1) Includes both high- and low-illuminance conditions to reflect day and night operation; and

2) Applies to all functions controlled through ABC, some of which may draw more power during the day, while others may draw more at night.

3) Does not apply if ABC is not enabled by default.

This test setup has been used successfully to measure the ABC response of computer monitors. EPA welcomes comment on the specifics of the test conditions and its applicability to EVSE.

1) Lamp Type:

a) Standard spectrum halogen flood reflector lamp. The lamp shall not meet the definition of "Modified spectrum" as defined in 10 CFR 430.2 - Definitions[9].

b) Rated Brightness: 980 ± 5% lumens.

2) Light Source Alignment For Testing Products With ABC Enabled By Default:

a) There shall be no obstructions between the lamp and the UUT's Automatic Brightness Control (ABC) sensor (e.g., diffusing media, frosted lamp covers, etc.).

b) The center of the lamp shall be placed at a distance of 5 feet from the center of the ABC sensor.

c) The center of the lamp shall be aligned at a horizontal angle of 0° with respect to the center of the UUT's ABC sensor.

d) The center of the lamp shall be aligned at a height equal to the center of the UUT's ABC sensor with respect to the floor (i.e. the light source shall be placed at a vertical angle of 0° with respect to the center of the UUT's ABC sensor).

e) No test room surface (i.e., floor, ceiling, and wall) shall be within 2 feet of the center of the UUT's ABC Sensor.

f) Illuminance values shall be obtained by varying the input voltage of the lamp.

g) Figure 5 and Figure 6 provide more information on UUT and light source alignment.

[9] http://www.gpo.gov/fdsys/pkg/CFR-2011-title10-vol3/pdf/CFR-2011-title10-vol3-sec430-2.pdf

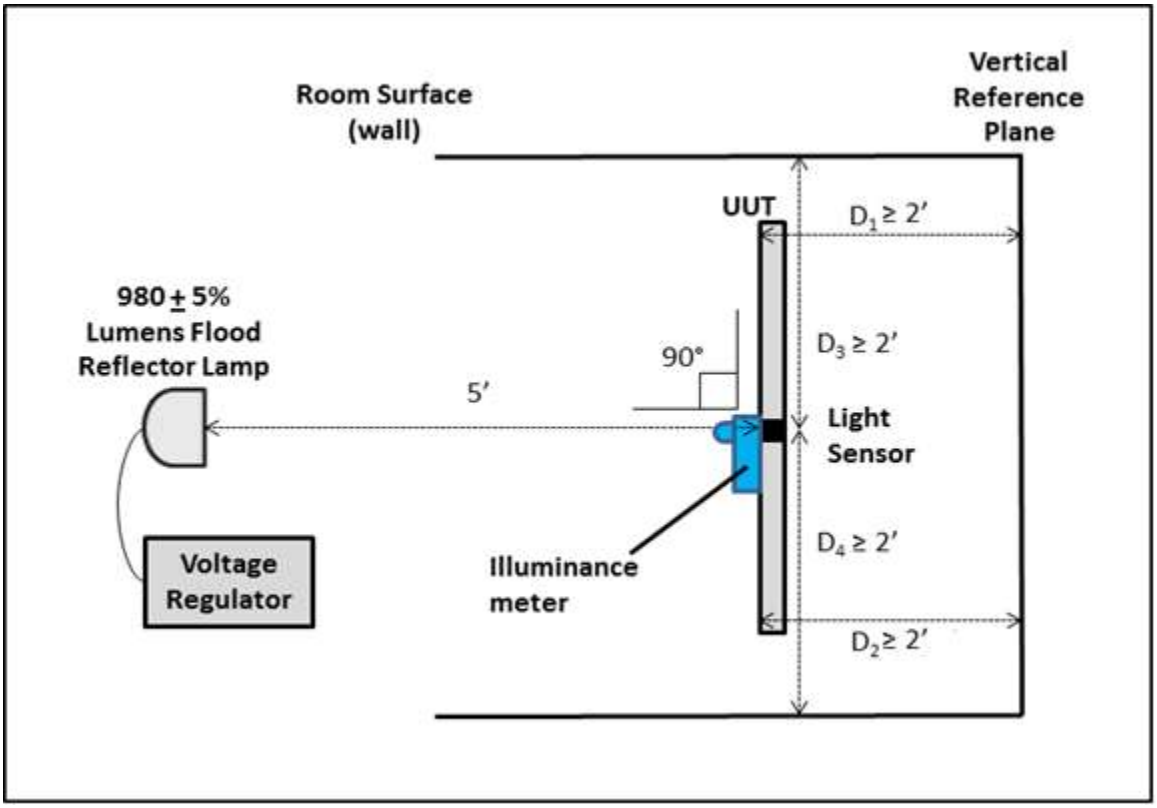


Figure 5: Test Setup - Top View

Notes:

- $D_1 = D_2$ with respect to vertical reference plane
- D_1 and D_2 indicate that the corners of the face of the UUT shall be at least 2 feet from the vertical reference plane
- D_3 and D_4 indicate that the center of the light sensor shall be at least 2 feet from the room walls

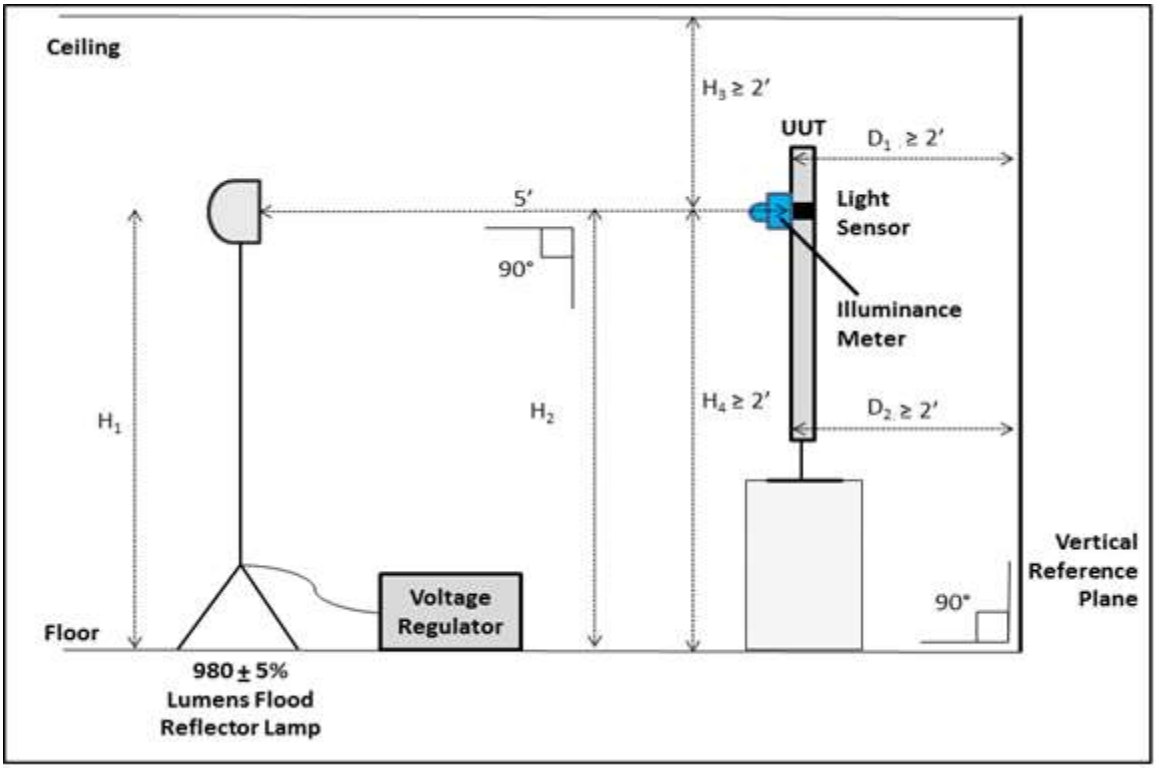


Figure 6: Test Setup - Side View

Notes:

- $D_1 = D_2$ with respect to vertical reference plane
- D_1 and D_2 indicate that the corners of the face of the UUT shall be at least 2 feet from the vertical reference plane
- Illuminance meter shall be removed for power measurements, after target illuminance achieved
- $H_1 = H_2$ with respect to horizontal reference plane (e.g. floor)
- H_3 and H_4 indicate that the center of the light sensor must be at least 2 feet from the floor and 2 feet from the ceiling
- Illuminance meter removed for power measurements, after target illuminance achieved

3) Setting Illuminance Conditions:

a) Power shall be disconnected from the UUT.

b) An illuminance meter shall be placed vertically, parallel to the UUT standing upright, such that the meter's sensor faces away from the UUT horizontally.

c) The illuminance meter shall be placed immediately in front of the UUT's automatic brightness control (ABC) sensor.

d) The lamp shall be adjusted such that the illuminance meter reads 300 ± 9.0 lux.

e) The illuminance meter shall be removed after target illuminance has been achieved and all testing conducted under the specified illuminance conditions.

f) After all testing has been completed under the high-illuminance conditions, the above steps a) through e) shall be repeated with a target illuminance equal to 12 ± 1.0 lux.

D) Test Conditions for Products with an Occupancy Sensors Enabled by Default:

1) Products with an Occupancy Sensors shall be positioned facing away from any testers, or have the sensor covered or otherwise disabled to be in an open position for the duration of the test.

E) Measurement Accuracy:

1) Power measurements with a value greater than or equal to 0.5 W shall be made with an uncertainty of less than or equal to 2% at the 95% confidence level.

2) Power measurements with a value less than 0.5 W shall be made with an uncertainty of less than or equal to 0.01 W at the 95% confidence level.

7 TEST PROCEDURES FOR ALL PRODUCTS

7.1 UUT Preparation

A) Prior to the start of testing, the UUT shall be initialized as follows:

1) Set up the UUT per the instructions in the supplied product manual.

2) Verify the VEM output is connected to the AC load

3) Connect the power meter to the following connections

a) Input Power Measurements:

1. AC RMS input current, RMS input voltage, and input power

b) Output Power Measurements:

1. AC RMS output current, RMS output voltage, and output power

2. For UUTs with multiple output connectors, measure output power at only one output connector, leaving the remaining output connector(s) in a docked position.

4) Connect an oscilloscope or other instrument to measure the duty cycle of the Control Pilot signal, the voltage at the VEM between “CP” and “Grnd” voltage measurement connections.

Note: EPA has removed the requirement to record the control pilot signal properties (voltage, frequency, and duty cycle). The control pilot shall still be measured to calculate the load current for the Operation Mode.

Note: Per stakeholder feedback, EPA has removed instructions for degaussing the power meter as the operation of a power meter may vary between laboratories.

5) Connect the UUT input connection to the IPMA.

6) Provide input power to the EVSE input connection.

7) Power on the UUT and perform initial system configuration, as applicable.

8) Ensure the UUT settings are in their as-shipped configuration, unless otherwise specified in this Test Method.

9) Report the AC RMS input voltage and frequency.

10) Report the test room ambient temperature, relative humidity, and the presence of ABC and occupancy sensor.

7.2 Auto Power Down (APD) Function

A) APD testing shall be conducted only for products that have an APD timer.

B) Conduct the UUT preparation procedure in section 7.1.

C) Ensure the APD timing is set to the default value.

D) Ensure any demand-response functionality is disabled.

1) If demand-response functionality cannot be disabled and a demand-response function occurs during a test, the results from the test shall be replaced with results from a substitute test.

E) State C: Plug in the UUT output connection to J1772 vehicle inlet on VEM. Connect S1 in the VEM.

F) Begin measuring the elapsed time to APD after the product ceases performance of all Primary Functions.

G) Measure and record the average power before APD over a 2 minute period.

H) Allow the UUT to automatically power-down.

I) Verify that the device is in the expected APD low-power state and record the time to APD.

J) Measure and record the average power after APD over a 2 minute period.

K) Power shall be measured according to IEC 62301 Ed 2.0-2011; with the additional guidance in Section 6 of this document.

Note: In response to stakeholder feedback that the forthcoming specification should also incentivize a transition from higher power modes to low power modes by requiring a power-down time limit, EPA has added a test for measuring an auto power down (APD) function in the situation that a vehicle continues to be connected to the EVSE following a charge.

7.3 Off Mode Testing

A) Off Mode testing shall be conducted only for products that have a manual off switch that disables secondary functions.

B) Conduct the UUT preparation procedure in section 7.1

C) Place the UUT in Off Mode using the manual switch.

D) Measure and record UUT input power.

Note: EPA has removed the language requiring measurement and recording of ground current from this and subsequent tests. However, it is still important to note that all required industry safety tests should be performed prior to ENERGY STAR testing.

E) Power shall be measured according to IEC 62301 Ed 2.0-2011; with the additional guidance in Section 6 of this document.

7.4 Partial On Mode and Idle Mode Testing

A) Testing shall be conducted for three operational states of the UUT (State A through State C)

B) Conduct the UUT preparation procedure in section 7.1

C) Ensure any demand-response functionality or timer is disabled.

1) If demand-response functionality or timer cannot be disabled and a demand-response or timer function occurs during a test, the results from the test shall be replaced with results from a substitute test.

Note: EPA added language to account for models with demand response and timer functions that cannot be disabled.

Note: EPA has removed the measurement accuracy requirements previously provided above since they are redundant with instructions in Section 5.H)5).

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

1) State A: Verify the UUT output connector is unplugged from VEM. Measure and record

a) UUT input power.

2) State B[10]: Plug in the UUT output connection to J1772 vehicle inlet on the VEM and verify S1 is open. Measure and record:

a) UUT input power.

Note: EPA has removed the language requiring measurement and recording of the Control Pilot from this and subsequent Partial On and Idle tests as behavior of the EVSE is specified by the SAE J1772 standard and does not need to be verified using the Control Pilot. The Control Pilot duty cycle will continue to be measured during the Operation Mode test to determine the available current.

3) State C[11]: Plug in the UUT output connection to J1772 vehicle inlet on VEM. Connect S1 in the VEM. Measure and record:

a) UUT input power; and

b) UUT output RMS voltage and output power (to verify zero output power).

E) Power shall be measured according to IEC 62301 Ed 2.0-2011; with the additional guidance in Section 6 of this document.

[10] This state represents a vehicle connected but not ready to accept current.

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

7.5 Operation Mode Testing[12]

A) Testing shall be conducted with the VEM in State C (S1 connected). On Mode Testing will be repeated with the VEM in State D (S2 connected) only for EVSE that operate a ventilation fan as required by a vehicle in State D. If the UUT does not operate a ventilation fan, testing with the VEM in State D is not required.

B) Ensure any demand-response functionality or timer is disabled.

1) If demand-response functionality or timer cannot be disabled and a demand-response or timer function occurs during a test, the results from the test shall be replaced with results from a substitute test.

Note: EPA added language to account for models with demand response and timer functions that cannot be disabled.

C) Determine the UUT available current.

1) Conduct the UUT preparation procedure in section 7.1.

2) State C: Plug in the UUT output connection to J1772 vehicle inlet on VEM. Connect S1 in the VEM.

3) Calculate the available current from the measured Control Pilot Duty Cycle per Table 3.

Table 3: Available Current Calculation from Control Pilot Duty Cycle (SAE J1772)

Duty Cycle (%)	Available Current (A)
10% ≤ Duty Cycle ≤ 85%	% Duty Cycle x 0.6
85% < Duty Cycle ≤ 96%	(% Duty Cycle – 64) x 2.5

Note: EPA has removed instructions on obtaining the available current from the UUT nameplate and comparing it to the value obtained through the Control Pilot. Under real-world conditions, an electric vehicle will load the EVSE up to the maximum specified by the Control Pilot, without reference to the nameplate.

EPA has removed the measurement accuracy requirements previously provided above since they are redundant with instructions in Section 5.H)5). The tolerances for setting the current in Table 4 remain.

D) Warm-up

1) Engage the AC load and draw full current output for 30 minutes or more.

2) Only one warm-up period of 30 minutes is required for each unit under test at the beginning of the test procedure.

Note: EPA has combined all the warm-up instructions in this section and placed them following the determination of available current.

[12] 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.

E) Measurement

1) After the 30 minute warm-up period, the technician shall monitor AC input power for a period of 5 minutes to assess the stability of the unit under test.

a) If the input power level does not drift by more than 1 percent from the maximum value observed over the 5-minute period, the unit under test can be considered stable and measurements can be recorded at the end of the 5-minute period.

b) If AC input power is not stable over a 5-minute period, the technician shall follow the guidelines established by IEC Standard 62301 for measuring average power or accumulated energy over time for both input and output.

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

a) RMS input current;

b) RMS input voltage;

c) Input power;

Note: EPA has removed the power factor and ground current measurements from the test method.

d) RMS output current;

e) RMS output voltage;

f) Output power;

g) Power Loss; and

Note: EPA will collect the power loss in addition to the percent efficiency per stakeholder feedback that it could inform the specification development process.

h) Calculated efficiency (output power / input power).

3) Repeat for all loading conditions in Table 4 that are less than or equal to the full current output capability of the UUT, in sequence from Loading Condition 2 to Loading Condition 4.

4) Measurements at subsequent loading conditions shall be conducted under the 5-minute stability guidelines in step 1), above.

Note: EPA has combined all the loading and measurement instructions in this section and placed them following the warm-up procedure.

Table 4: Loading Conditions for UUT

	Test Condition Current (A)	Example for 80 A capable UUT	Example for 32 A capable UUT	Example for 16 A capable UUT
Loading Condition 1	Available Current (determined in Section 7.5.C), above) ± 2%.	80.0 A	32.0 A	16.0 A
Loading Condition 2	30.0 A ±0.6 A	30.0 A	30.0 A	Do not test
Loading Condition 3	15.0 A ±0.3 A	15.0 A	15.0 A	15.0 A

Loading Condition 4	4.00 A ±0.1A	4.0 A	4.0 A	4.0 A

Note: Stakeholders provided feedback that since lower currents are not practical and may not be supported by SAE J1772, the low-current measurement of 2 A in the Loading Conditions table should be increased to 6–8 A. In response, EPA has changed the fourth loading condition in Table 4 to 4 A to reflect continuing power draw to condition battery temperature after charging is complete. EPA welcomes comment on how well Loading Condition 4 (4 A) represents low-current maintenance modes as well as the number of hours per day an EVSE would be limited to low-current operation and the number of hours it would actually operate in such a mode.

7.6 Full Network Connectivity Testing

A) For products with data/networking capabilities, the presence of Full Network Connectivity shall be determined by testing the UUT for network activity in Partial On Mode according to section 6.7.5.2 of Consumer Electronics Association (CEA) 2037-A, Determination of Television Set Power Consumption, with the following guidance:

1) The UUT shall be connected to a network per Section 6.1B)2) of this test method prior to the test; and

2) The UUT shall be placed into Partial On Mode in place of Standby-active, Low Mode.

7.7 Connected Functionality Verification Testing

TBD.

Note: EPA continues to include a placeholder for connected EVSE test methodology and plans to propose criteria or parameters for connected functionality in the specification, prior to developing any pertinent or necessary test methodology. EPA anticipates keeping in step with how connected functionality is addressed in other ENERGY STAR product specifications, such as pool pumps and home appliances, as well as relevant aspects of the current specification under development for connected thermostats. EPA anticipates proposing criteria for EVSE that ship with connected functionality that ensures both consumers and utilities will benefit from this added feature. EPA expects that the Draft 1 criteria will address the following elements that can be considered under connected functionality:

1) Open standards & open access, either at the level of the device and/or the cloud;

2) Grid response, including demand response and possibly ancillary services;

3) Price response; and

4) Metering.

EPA seeks feedback from stakeholders on whether the Draft 1 specification criteria should include any additional elements.

EPA expects ENERGY STAR EVSE with connected functionality will enable added consumer and grid benefits, including:

1) Consumer savings through automatic shifting of EVSE charging in response to price signals, in accordance with consumer preferences;

2) Enhanced consumer understanding of EV fuel costs through availability of EVSE meter data;

3) Consumer and utility/load management entity benefits from Demand Response programs; and

4) Utility/load management entity verification of EVSE load shed, and notification of consumer override, through limited sharing of data that will respect consumers' privacy.

In order to inform development of ENERGY STAR EVSE Connected Functionality criteria, EPA seeks feedback from stakeholders on the following topics:

1) Open Standards and Open Access: Are the definitions and criteria as specified in Sections 1.6 and 4.1 of the Version 1.1 ENERGY STAR Pool Pumps specification appropriate for and applicable to connected EVSE?

2) Demand Response: What level of specificity is appropriate? Should EPA define default responses, mandate multiple response modes, configurability and the like? Are there ancillary services (e.g., temporarily increased load, power factor correction) that EVSE could provide that would be of value to utilities?

3) Price Response: What are the key use cases, e.g., price responsiveness within the EVSE, ability to participate in utility price response programs, ability to integrate with price aware/responsive Energy Management Systems?

4) Metering: What are the key use cases and how do EVSE's currently provide metering data, if at all? If applicable, what level of precision is appropriate?

5) Existing Certification Programs: Are there programs under development or existing programs for certification of EVSE connected functionality that ENERGY STAR can leverage?