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Center for Evaluation of Clean Energy Technology

# Test Specification – Characterization of Accessory Loads on a Vehicle 12 Volt System

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(CECET)**

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## Revision History Log

Revision No.	Revisions Description	Effective Date	Revised/Reviewed By	Approved By
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## Table of Contents

<b>1</b>	<b>Objective .....</b>	<b>4</b>
<b>2</b>	<b>Test Conduct .....</b>	<b>5</b>
<b>3</b>	<b>Initial Conditions &amp; Prerequisites .....</b>	<b>6</b>
<b>4</b>	<b>Test Activity Requirements .....</b>	<b>8</b>
<b>5</b>	<b>Glossary .....</b>	<b>10</b>
<b>6</b>	<b>References .....</b>	<b>12</b>

## 1 Objective

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The objective of this Test Specification is to outline the methods for testing the load of accessories put on the 12 V system of advanced vehicles participating in the Advanced Vehicle Testing and Evaluation (AVTE) program or in other advanced vehicle testing activities. This Test Specification establishes methods to quantitatively evaluate the load put on the 12 V system by each individual accessories on the vehicle. The actual specific steps for the test conduct are listed and described in the associated Center for Evaluation of Clean Energy Technology (CECET) internal Work Instruction document.

## 2 Test Conduct

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Documentation resulting from usage of this Test Specification shall be consistent, easy to understand, easy to read, and readily reproducible. All documentation required to complete testing shall be completed, approved, and ready for issue prior to commencing the testing it addresses. The following will abide by company policy:

- Review and approval of test results
- Storage and retention of records during and following testing activities
- Recording of any deviation from the outlined procedures and the reason for the deviation

### 3 Initial Conditions & Prerequisites

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Prior to conduct of any portion of the testing, the following initial conditions and prerequisites shall be met. Satisfactory completion of these items should be verified.

#### 3.1 Personnel

Personnel conducting testing under this Test Specification, i.e., the Test or Project Engineer(s), shall be familiar with the requirements of this Test Specification, shall be trained in accordance with company policy, and shall be certified by a Mandated Reviewer prior to commencing any testing activities. This requirement includes training in all aspects of the Test Specification, including its automatic shutdowns and safety procedures.

#### 3.2 Instrumentation

3.2.1 All instrumentation used during testing shall be calibrated. The calibration shall be performed and documented in accordance with company policy.

3.2.2 All instrumentation shall have the accuracies and resolutions noted. Unless specific exceptions have been made by a Mandated Reviewer, the following identifies the minimum instrumentation specification that shall be installed and employed during the testing.

##### 3.2.3 Time

- A) Accuracy  $\pm 0.1\%$
- B) Resolution of 0.1 s

##### 3.2.4 Speed

- A) Accuracy of  $\pm 0.25$  mph (0.4km/h)
- B) Resolution of 0.1 mph (0.2 km/h)

##### 3.2.5 Temperature

- A) The temperature indicating devices must have a resolution of 2 °F (1 °C) and an accuracy of  $\pm 2$  °F ( $\pm 1$  °C). The sensing element shall be shielded from radiant heat sources.

##### 3.2.6 Atmospheric Pressure

- A) A barometer with an accuracy of  $\pm 0.2$  inches Hg ( $\pm 0.7$  kPa) is necessary.

##### 3.2.7 Tire Pressure

- A) Accuracy requirement is  $\pm 0.5$  psi ( $\pm 4$  kPa).

##### 3.2.8 Engine RPM (if applicable)

- A) Accuracy requirement is  $\pm 50$  RPM

##### 3.2.9 Battery Current (if applicable)

- A) Accuracy requirement is  $\pm 1$  A

##### 3.2.10 Battery Voltage (if applicable)

- 1) Accuracy requirement is  $\pm 1$  V

- 3.2.11 Motor Current (if applicable)
- 3.2.12 Accuracy requirement is  $\pm 1$  A

## 4 Test Activity Requirements

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This section addresses testing required to meet the stated purpose and objective of this Test Specification.

### 4.1 Collected Test Data

The following data shall be collected during conduct of testing specified by this procedure. Overall error in recording or indicating instruments shall not exceed  $\pm 2\%$  of the maximum value of the variable being measured.

- 4.1.1 12 V battery voltage versus time
- 4.1.2 12 V battery current versus time
- 4.1.3 12 V battery power versus time
- 4.1.4 Alternative power source<sup>1</sup> voltage versus time
- 4.1.5 Alternative power source current versus time
- 4.1.6 Alternative power source power versus time

### 4.2 Test Conditions

- 4.2.1 All components that supply power to the 12 V system should be instrumented with both current and voltage<sup>2</sup> monitoring equipment such that the load supplied can be traced to a particular supply.
- 4.2.2 Current measurement device orientation should be setup such that the power out of a supply is negative and the current into a supply, where applicable, is positive.
- 4.2.3 Testing should take place with the vehicle in two states: when only the accessories are active and being supplied by the 12 V battery and; when the vehicle is capable of being driven. Performing this test with the vehicle in the state where certain accessories are powered solely from the 12 V battery reduces the complexity of determining the load for any particular accessory. It also allows for a determination of what accessories are in fact active without the vehicle needing to be in a drivable state, if desired.
- 4.2.4 Each accessory load should be determined based on a delta change in current from a baseline value when the accessory is turned on.
- 4.2.5 Each accessory should be individually turned on and measured, unless the load has multiple power levels, such as a blower motor, in which case each power level should be measured. The power levels can be built upon each other and do not need to return to baseline load in between.

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<sup>1</sup> An alternative power source could be an alternator, DC/DC converter, or any other device or mechanism that supplies power to the 12 V system on the vehicle.

<sup>2</sup> Voltage only needs to be monitored if a component is operating at a different nominal voltage than the 12 V system.



4.2.6 An appropriate time should be allowed for the electrical load to enter a steady state after turning the accessory on or off.

## 5 Glossary

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**AVTE:** Advanced Vehicle Testing and Evaluation

**CAN:** Controller area network

**CECET:** Center for Evaluation of Clean Energy Technology (CECET)

**Charge-Depleting (CD) Mode:** An operating mode in which the energy storage system (ESS) state of charge (SOC) is depleted (not continuously, but the trend is depletion) while the vehicle is driven. May be ESS-Only (i.e., the vehicle operates solely on energy from the ESS) or Blended CD (i.e., the vehicle operates on energy from both the ESS and the consumable fuel energy converter (CFEC)).

**Charge-Sustaining (CS) Mode:** An operating mode in which the energy storage system (ESS) state of charge (SOC) is maintained within a prescribed range by operation of a consumable fuel energy converter (CFEC).

**Consumable Fuel Energy Converter (CFEC):** An engine which consumes fuel to produce work (either electrical or mechanical).

**Curb Weight:** The total weight of the vehicle including batteries, lubricants, and other expendable supplies but excluding the driver, passengers, and other payloads.

**Effective Date:** After a document has been reviewed and approved, the first date the procedure can be utilized in an official capacity.

**Energy Storage System (ESS):** A component or system of components that stores energy and for which its supply of energy is rechargeable by an electric motor-generator system, an off-vehicle energy source, or both. Examples of ESSs include batteries, capacitors, and electromechanical flywheels.

**ESS-Only Mode:** An operator selectable vehicle operating mode in which the CFEC is disabled and the vehicle operates solely on energy from the ESS.

**Gradeability:** The maximum percent grade which the vehicle can traverse for a specified time at a specified speed. The gradeability limit is the grade upon which the vehicle can just move forward.

**Initial Conditions:** Conditions that must exist prior to an event occurring.

**Initial State of Charge (SOC):** ESS SOC at the beginning of a test.

**Mandated Reviewer:** The individual(s) responsible for the implementation of the AVTE program and of other advanced vehicle testing activities.

**Prerequisites:** Requirements that shall be met or resolved prior to an event occurring.

**Shall:** This word is used to indicate an item which requires adherence without deviation. 'Shall' is used to identify the binding requirements in a statement. A go or no-go criterion.

**Should:** This word is used to identify an item, which requires adherence if at all possible. 'Should' statements identify preferred conditions.

**State of Charge (SOC):** The ESS SOC is defined as the present capacity, (ampere-hours or watt-hours or miles), expressed as a percentage of the total available.

**Test or Project Engineer:** The individual(s) assigned responsibility for the conduct of any given test.

**Test Mass (Weight):** The mass [weight] of the vehicle as tested, including driver and all instrumentation

**Tractive Force:** The force available from the driving wheels at the driving wheel/ground interface.

## 6 References

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None