

ETA-HTP07

Revision 0

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Road Course Handling Test

Prepared by

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1. Objective

The objective of this procedure is to identify methods for qualitatively evaluating the handling characteristics of vehicles participating in HEV America. These methods are not meant to supersede those of the testing facility, those specifically addressed by SAE Test Standards, nor of any regulatory agency which may have or exercise control over the covered activities.

2. Purpose

The purpose of this test is: (1) to determine the time required for a vehicle to safely negotiate a SCCA-style Road Handling Course (gymkhana-style course); and (2) to determine vehicle durability under high stress conditions. No inferences concerning the speed, range or gradeability characteristics of any vehicle should be drawn from this test. This activity is meant to test the vehicle as a total system. Tests of specific subsystems or portions of individual subsystems are addressed by other Test Procedures. This testing and data acquisition meets the requirements specified in the HEV America Vehicle Specification.

3. Documentation

Documentation addressed by this procedure shall be consistent, easy to understand, easy to read, and readily reproducible. This documentation shall contain enough information to "stand alone"; that is, be self-contained to the extent that all individuals qualified to review it could be reasonably expected to reach a common conclusion, without the need to review additional documentation. Review and approval of test documentation shall be in accordance with ETA-HAC04, "Review of Test Results." Storage and retention of records during and following testing activities shall be completed as described in Procedure ETA-HAC01, "Control, Close-out and Storage of Documentation."

4. Initial Conditions and Prerequisites

Prior to conduct of any portion of the testing, the following initial conditions and prerequisites shall be met. Satisfactory completion of these items shall be verified as complete and recorded on the Road Course Handling Test Data Sheet, Appendix A.

- 4.1 Personnel conducting testing under this procedure shall be familiar with the requirements of this procedure, any applicable SAE Test Instructions, the Administrative Control Procedures, and certified by the Program Manager or Test Manager prior to commencing any testing activities.

- 4.2 Ambient temperature during road testing shall be within the range of 32°F (0°C) to 100°F (38°C).
- 4.3 RESS temperatures at the beginning of the test shall be greater than 60°F (16°C), shall be less than 120°F (49°C) and should be less than 100°F (38°C)
- 4.4 The average wind speed at the test site during the test shall not exceed 10 mph (16 km/h). Wind gusts shall not exceed 12.3 mph (20 kph).
- 4.4 Vehicles shall be tested in their normal configuration with normal appendages (mirrors, bumpers, hubcaps, etc.). Certain items (hub caps, etc.) may be removed where necessary for safety.
- 4.5 The vehicle shall be tested at curb weight plus 332 pounds.
- 4.6 Supplier's recommended tires shall be used.
- 4.7 Supplier's recommended lubricants shall be employed.
- 4.8 For vehicles operable in "RESS only mode," verify the RESS is at 100% SOC in accordance with the requirements of ETA-TP08, "RESS Charging Procedure." For vehicles operable in "normal operation mode," verify the RESS is at an Initial State of Charge (SOC) achieved by operating the vehicle for at least 5 miles (8 kilometers) at a constant speed of 35 mph (56 kph).
- 4.9 Overall error in recording or indicating instruments shall not exceed $\pm 2\%$ of the maximum value of the variable being measured, unless otherwise excepted. Periodic calibration shall be performed and documented to ensure compliance with this requirement.
- 4.10 Complete or verify completed procedures ETA-HAC06, "Receipt Inspection," and ETA-HTP11, "Vehicle Verification."
- 4.11 The road surface type and condition identified and the course route shall be noted. Grade shall be less than 1%.
- 4.12 Any deviation from the test procedure and the reason for the deviation shall be approved in advance and so noted on the appropriate data sheet(s), in accordance with ETA-HAC02, "Control of Test Conduct."
- 4.13 Accessories shall not be used during this test.
- 4.14 The driver of the vehicle being tested shall have driven at least fifteen practice laps on the specific course to become familiar with the layout of the course and to clean the track of debris. These practice laps may have been completed in an internal combustion vehicle or an electric vehicle.
- 4.15 The course shall be laid out in accordance with Appendix C.

- 4.16 The course shall be “swept” prior to commencement of testing for each vehicle. This sweeping may be completed mechanically, by picking up debris by hand, or by repetitive driving of the course. If repetitive driving of the course is used, then a visual inspection of the course shall be completed prior to any testing.
- 4.17 All documentation required to complete the testing identified in the HEV America Vehicle Specification shall be completed, approved and issued prior to commencing the testing it addresses. In all cases, official testing and data collection shall not be commenced prior to the effective date of the procedures.
- 4.18 Metrology used in the conduct of this test procedure shall be recorded on Appendix B.

5. Road Course Test

This test will determine the time in which a vehicle can safely negotiate a modified "road course." A single driver shall be used for all vehicles over a common course. The course shall be set up and maintained throughout HEV America testing.

All vehicles shall be tested in "normal operating mode." Additionally, vehicles capable of operating in "RESS only mode" shall be tested again in the "RESS only mode" at 100% RESS SOC. Two runs through the course are conducted in each mode to ensure the driver is familiar with the vehicle characteristics in that mode. The times of the two runs in each mode are averaged to obtain the official time in that mode.

NOTE

All steps shall be completed in the order written. Deviations from any step or requirement shall have the prior written approval of the Test Manager or Test Engineer in accordance with Procedure ETA-HAC02, “Control of Test Conduct.”

NOTE

During this testing, if the vehicle fails electrically or mechanically for any reason, the vehicle shall be removed from this test area (and the test schedule) until the Supplier can effect the necessary repairs. See ETA-HAC02, "Control of Test Conduct" for additional details.

- 5.1 The road course, including elapsed time counters-recorders, shall be set up on a rolled asphalt area. It shall be constructed using traffic cones or

similar non-damaging devices. The course shall be constructed as shown in Appendix C.

- 5.2 Place/verify placement of the elapsed time counters as depicted on Appendix C.
- 5.3 Record the following environmental conditions on Appendix A.
 - 5.3.1 Range of ambient temperature during the test;
 - 5.3.2 Range of wind velocity during the test;
 - 5.3.3 Range of wind direction during the test;
- 5.4 Move the vehicle to the starting point on the track.
- 5.5 For vehicles operable in "RESS only mode," verify the RESS is at 100% SOC in accordance with the requirements of ETA-TP08, "RESS Charging Procedure." For vehicles operable in "normal operation mode," verify the RESS is at an Initial State of Charge (SOC) achieved by operating the vehicle for at least 5 miles (8 kilometers) at a constant speed of 35 mph (56 kph).
- 5.7 Verify vehicles are in "normal operating mode."
- 5.6 When the driver is ready to commence the first run, the driver shall start the test by accelerating into the test course.
- 5.7 Maneuver the vehicle through the test course at the highest safe speed achievable.
- 5.8 After completion of the run, the vehicle shall be rapidly decelerated to a stop. Record or verify the recording of the elapsed time of the run on Appendix A.
- 5.9 The vehicle shall be returned to the starting area for the second run.
- 5.10 Record the RESS SOC on Appendix A.
- 5.11 Allow at least five minutes to pass prior to proceeding to the next run.. Record the elapsed time and driver comments on Appendix A.
- 5.12 When the driver is ready to commence the next run, the driver shall start the test by accelerating into the test course.
- 5.13 Maneuver the vehicle through the test course at the highest safe speed achievable.
- 5.14 After completion of the run, the vehicle shall be decelerated to a stop. Record the elapsed time, RESS SOC and any driver comments on Appendix A.

NOTE

Testing is now complete for vehicles operable only in "normal operation mode."
Proceed to Section 5.27 to record final data. For vehicles operable in
"RESS only mode," continue testing with Section 5.15

- 5.15 For vehicles operable in "RESS only mode." verify the RESS is at 100% SOC or charge accordance with the requirements of ETA-TP08, "RESS Charging Procedure."
- 5.16 Verify the vehicle is in "RESS only mode."
- 5.17 Allow at least five minutes to pass prior to proceeding to the next run. Record the elapsed wait time on Appendix A.
- 5.18 When the driver is ready to commence the next run, the driver shall start the test by accelerating into the test course.
- 5.19 Maneuver the vehicle through the test course at the highest safe speed achievable.
- 5.20 After completion of the run, the vehicle shall be decelerated to a stop. The driver shall record the elapsed time and any comments on Appendix A.
- 5.21 The vehicle shall be returned to the starting area for the next run.
- 5.22 Record the RESS SOC on Appendix A.
- 5.23 Allow at least five minutes to pass prior to proceeding to the next run. Record the elapsed wait time on Appendix A.
- 5.24 When the driver is ready to commence the next run, the driver will start the test by accelerating into the test course.
- 5.25 Maneuver the vehicle through the test course at the highest safe speed achievable.
- 5.26 After completion of the run, the vehicle shall be decelerated to stop. Record the elapsed time, RESS SOC and any driver comments on Appendix A.

NOTE

Testing is now complete for vehicles operable in "RESS only mode." Proceed to
Section 5.27 to record final data.

- 5.27 When the vehicle has completed running the course in all applicable modes, record the following data on Appendix A:
- 5.27.1 Date and time of test phase completion
 - 5.27.2 Kilowatt-hour indicator reading, in kilowatt-hours
 - 5.27.3 Elapsed time for each run
 - 5.27.4 Cones hit/dislodged during each run
 - 5.27.5 Equipment failures, if any;
 - 5.27.6 Equipment abnormalities, if any;
 - 5.27.7 Driver Notes, if any
- 5.28 Calculate average times for paired runs and enter on Appendix A

6. Glossary

- 6.1 Curb Weight - The total weight of the vehicle including batteries, lubricants, and other expendable supplies but excluding the driver, passengers, and other payloads.
- 6.2 Depth of Discharge (DOD) - As used in this procedure, the energy removed from the RESS expressed as miles, amp-hours or kilowatt-hours which represents a state of charge of the RESS as a percentage of the total RESS capacity.
- 6.3 Effective Date - The date, after which the procedure has been reviewed and approved, that the procedure can be utilized in the field for official testing.
- 6.4 Gross Vehicle Weight Rating (GVWR) - The maximum design loaded weight of the vehicle specified by the Supplier.
- 6.5 HEV America – Hybrid Electric Vehicle America Performance Test Program, the DOE sponsored test program for independently assessing the performance of vehicles submitted for testing.
- 6.6 Initial Conditions - Conditions that must exist prior to an event occurring.
- 6.7 Initial State of Charge (SOC) - RESS SOC at the beginning of a test.
- 6.8 Prerequisites - Requirements that must be met or resolved prior to an event occurring.
- 6.9 Program Manager - As used in this procedure, the individual within Electric Transportation Applications responsible for oversight of HEV America. [Subcontract organizations may have similarly titled individuals, but they are not addressed by this procedure.]

- 6.10 Shall - Items which require adherence without deviation. Shall statements identify binding requirements. A go, no-go criterion.
- 6.11 Should - Items which require adherence if at all possible. Should statements identify preferred conditions.
- 6.12 State of Charge (SOC) - For vehicles operable in "RESS only mode," the SOC of the RESS is defined as the present capacity, (amperes-hours or watt-hours or miles), expressed as a percentage of the total available. The 100% SOC basis (available ampere-hours, kilowatt hours or miles) is determined by the actual discharge capability of the RESS when discharged to the requirements of the 45 mph Constant Speed Range Test portion of procedure ETA-HTP04.
- 6.13 Test Director - The individual within Electric Transportation Applications responsible for all testing activities associated with HEV America.
- 6.14 Test Director's Log - A daily diary kept by the Test Director, Program Manager, Test Manager or Test Engineer to document major activities and decisions that occur during the conduct of a Performance Test Evaluation Program. This log is normally a running commentary, utilizing timed and dated entries to document the days activities. This log is edited to develop the Daily Test Log published with the final report for each vehicle.
- 6.15 Test Engineer - The individual(s) assigned responsibility for the conduct of any given test. [Each contractor/subcontractor should have at least one individual filling this position. If so, they shall be responsible for adhering to the requirements of this procedure.]
- 6.16 Test Manager - The individual within Electric Transportation Applications responsible for the implementation of the test program for any given vehicle(s) being evaluated to the requirements of HEV America. [Subcontract organizations may have similarly titled individuals, but they are not addressed by this procedure.]

7. References

- 7.1 HEV America Vehicle Specification
- 7.2 ETA-HAC01 - "Control, Close-out and Storage of Documentation"
- 7.3 ETA-HAC02 - "Control of Test Conduct"
- 7.4 ETA-HAC04 - "Review of Test Results"
- 7.5 ETA-HAC06 - "Receipt Inspection"
- 7.8 ETA-HTP11 - "Vehicle Verification"

**APPENDIX-A
Road Course Test
Data Sheet (Page 1 of 4)**

VIN Number: _____

Project No.:	Test Date(s):
Root File No.:	
Test Driver:	(Initials) (Date)
Test Engineer:	(Initials) (Date)

Vehicle Setup

VEHICLE WEIGHTS AS TESTED WITH DRIVER & INSTRUMENTATION (Curb weight plus 332 pounds)			
Left Front: <small>(lbs or kg)</small>	Right Front: <small>(lbs or kg)</small>	Total Front: <small>(lbs or kg)</small>	Percent Front: %
Left Rear: <small>(lbs or kg)</small>	Right Rear: <small>(lbs or kg)</small>	Total Rear: <small>(lbs or kg)</small>	Percent Rear: %
		Total Weight: <small>(lbs or kg)</small>	
INSTALLED TIRES (Placard or sidewall whichever is less)			
Left Front		Right Front	
Pressure: <small>(psi or kPa)</small>		Pressure: <small>(psi or kPa)</small>	
Left Rear		Right Rear	
Pressure: <small>(psi or kPa)</small>		Pressure: <small>(psi or kPa)</small>	

Track/Weather Conditions

Test Track Location:	Track Grade: % <small>(<1%)</small>
Ambient Temperature (initial): <small>(40-120°F or 5-53°C)</small>	Ambient Temperature (final): <small>(40-120°F or 5-53°C)</small>
Wind Velocity (initial): <small>(<10 mph or 16 km/h)</small>	Wind Velocity (final): <small>(<10 mph or 16 km/h)</small>
Wind Direction (initial): °	Wind Direction (completion): °

**APPENDIX-A
Road Course Handling
Test Data Sheet (Page 2 of 4)**

VIN Number: _____ **(Vehicle in "normal operation mode")**

Sequence No: 1	File No.:	Direction of Travel:
Time (initial):		Time (final):
Odometer (initial): <small>(miles or kilometers)</small>		Odometer (final): <small>(miles or kilometers)</small>
State of Charge (initial): <small>(SOC,kWh,Ah)</small>		State of Charge (final): <small>(SOC,kWh,Ah)</small>
RESS Temp (initial): <small>(°F or °C)</small>		RESS Temp (final): <small>(°F or °C)</small>
Comments (initials/date): Number of cones hit/dislodged: _____ Elapsed Time: _____ <p align="center"><i>Note: Allow at least 5 minutes to pass prior to proceeding to the next run.</i></p>		

(Vehicle in "normal operation mode")

Sequence No: 2	File No.:	Direction of Travel:
Time (initial):		Time (final):
Odometer (initial): <small>(miles or kilometers)</small>		Odometer (final): <small>(miles or kilometers)</small>
State of Charge (initial): <small>(SOC,kWh,Ah)</small>		State of Charge (final): <small>(SOC,kWh,Ah)</small>
RESS Temp (initial): <small>(°F or °C)</small>		RESS Temp (final): <small>(°F or °C)</small>
Comments (initials/date): Number of cones hit/dislodged: _____ Elapsed Time: _____ <p align="center"><i>Note: Allow at least 5 minutes to pass prior to proceeding to the next run.</i></p>		

**APPENDIX-A
Road Course Handling Test
Data Sheet (Page 3 of 4)**

VIN Number: _____

("RESS only mode")

Sequence No: 3	File No.:	Direction of Travel:
Time (initial):		Time (final):
Odometer (initial): <small>(miles or kilometers)</small>		Odometer (final): <small>(miles or kilometers)</small>
State of Charge (initial): <small>(SOC,kWh,Ah)</small>		State of Charge (final): <small>(SOC,kWh,Ah)</small>
RESS Temp (initial): <small>(°F or °C)</small>		RESS Temp (final): <small>(°F or °C)</small>
Comments (initials/date): Number of cones hit/dislodged: _____ Elapsed Time: _____ <p align="center"><i>Note: Allow at least 5 minutes to pass prior to proceeding to the next run.</i></p>		

("RESS only mode")

Sequence No: 4	File No.:	Direction of Travel:
Time (initial):		Time (final):
Odometer (initial): <small>(miles or kilometers)</small>		Odometer (final): <small>(miles or kilometers)</small>
State of Charge (initial): <small>(SOC,kWh,Ah)</small>		State of Charge (final): <small>(SOC,kWh,Ah)</small>
RESS Temp (initial): <small>(°F or °C)</small>		RESS Temp (final): <small>(°F or °C)</small>
Comments (initials/date): Number of cones hit/dislodged: _____ Elapsed Time: _____ <p align="center"><i>Note: Allow at least 5 minutes to pass prior to proceeding to the next run.</i></p>		

**APPENDIX-B
Vehicle Metrology Setup Sheet
(Page 1 of 1)**

VIN Number: _____

Instrument/Device:	Calibration Due Date:	Initials / Date:
Fifth Wheel S/N:		
Fifth Wheel Calibrator S/N:		
DAS S/N:		
DAS Set-up Sheet S/N		
kWh Meter S/N:		
Shunt S/N:		
Tire Pressure Gauge S/N:		
Misc:		
Misc:		
Misc:		
Misc:		
Comments (initials/date):		
Completed By:		
_____ <small>(Printed Name)</small>	_____ <small>(Signature)</small>	_____ <small>(Date)</small>
Reviewed By (QA):		
_____ <small>(Printed Name)</small>	_____ <small>(Signature)</small>	_____ <small>(Date)</small>
Approved By:		
_____ <small>(Printed Name)</small>	_____ <small>(Signature)</small>	_____ <small>(Date)</small>

APPENDIX-C Handling Course Layout (Page 1 of 1)

