

ETA-HITP07

Revision 0

Effective November 1, 2004

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 HICEV 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 HICEV 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-HIAC04, "Review of Test Results." Storage and retention of records during and following testing activities shall be completed as described in Procedure ETA-HIAC01, "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 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 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.
- 4.9 Complete or verify completed procedures ETA-HIAC06, "Receipt Inspection," and ETA-HITP11, "Vehicle Verification."
- 4.10 The road surface type and condition identified and the course route shall be noted. Grade shall be less than 1%.
- 4.11 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-HIAC02, "Control of Test Conduct."
- 4.12 Accessories shall not be used during this test.
- 4.13 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.
- 4.14 The course shall be laid out in accordance with Appendix C.
- 4.15 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.
- 4.16 All documentation required to complete the testing identified in the HICEV 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.
- 4.17 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 HICEV America testing.

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-HIAC02, "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-HIAC02, "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 When the driver is ready to commence the first run, the driver shall start the test by accelerating into the test course.
- 5.6 Maneuver the vehicle through the test course at the highest safe speed achievable.
- 5.7 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.
- 5.8 The vehicle shall be returned to the starting area for the second run.
- 5.9 Allow at least five minutes to pass prior to proceeding to the next run. Record the elapsed time and driver comments on Appendix A.
- 5.10 When the driver is ready to commence the next run, the driver shall start the test by accelerating into the test course.
- 5.11 Maneuver the vehicle through the test course at the highest safe speed achievable.
- 5.12 After completion of the run, the vehicle shall be decelerated to a stop. Record any driver comments on Appendix A.
- 5.13 When the vehicle has completed running the course in all applicable modes, record the following data on Appendix A:
 - 5.13.1 Date and time of test phase completion
 - 5.13.1 Elapsed time for each run
 - 5.13.2 Cones hit/dislodged during each run
 - 5.13.3 Equipment failures, if any
 - 5.13.4 Equipment abnormalities, if any
 - 5.13.5 Driver Notes, if any
- 5.14 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 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.
- 6.3 Gross Vehicle Weight Rating (GVWR) - The maximum design loaded weight of the vehicle specified by the Supplier.
- 6.4 HICEV America - Hydrogen Internal Combustion Engine Vehicle America Performance Test Program, the DOE sponsored test program for independently assessing the performance of vehicles submitted for testing.
- 6.5 Initial Conditions - Conditions that must exist prior to an event occurring.
- 6.6 Prerequisites - Requirements that must be met or resolved prior to an event occurring.
- 6.7 Program Manager - As used in this procedure, the individual within Electric Transportation Applications responsible for oversight of HICEV America.
- 6.8 Shall - Items which require adherence without deviation. Shall statements identify binding requirements. A go, no-go criterion.
- 6.9 Should - Items which require adherence if at all possible. Should statements identify preferred conditions.
- 6.10 Test Director - The individual within Electric Transportation Applications responsible for all testing activities associated with HICEV America.
- 6.11 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 day's activities. This log is edited to develop the Daily Test Log published with the final report for each vehicle.
- 6.12 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.]
- 6.13 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 HICEV America.

7. References

- 7.1 HICEV America Vehicle Specification
- 7.2 ETA-HIAC01 - "Control, Close-out and Storage of Documentation"
- 7.3 ETA-HIAC02 - "Control of Test Conduct"
- 7.4 ETA-HIAC04 - "Review of Test Results"

- 7.5 ETA-HIAC06 - "Receipt Inspection"
- 7.8 ETA-HITP11 - "Vehicle Verification"

**APPENDIX-A
Road Course Handling 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>
Comments (initials/date):		
Number of cones hit/dislodged: _____		
Elapsed Time: _____		
<i>Note: Allow at least 5 minutes to pass prior to proceeding to the next run.</i>		

(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>
Comments (initials/date):		
Number of cones hit/dislodged: _____		
Elapsed Time: _____		
<i>Note: Allow at least 5 minutes to pass prior to proceeding to the next run.</i>		

**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>
Comments (initials/date):		
Number of cones hit/dislodged: _____		
Elapsed Time: _____		
<i>Note: Allow at least 5 minutes to pass prior to proceeding to the next run.</i>		

("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>
Comments (initials/date):		
Number of cones hit/dislodged: _____		
Elapsed Time: _____		
<i>Note: Allow at least 5 minutes to pass prior to proceeding to the next run.</i>		

**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		
Tire Pressure Gauge S/N:		
Misc:		
Misc:		
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)

