

ETA-GTP004

Revision 1
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Electromagnetic Interference and Susceptibility Test

Prepared by

Electric Transportation Applications

Prepared by: _____

Garrett P. Beauregard

Date: _____

Approved by: _____

Donald B. Karner

Date: _____

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1 Objective

This procedure identifies the proper method for conducting tests to determine the susceptibility to electromagnetic interference and the propensity to cause such interference of a tractor being tested during the eGSEV America Performance Test Program. It shall not supersede the testing protocols of the vehicle's manufacturer, nor is it meant to supersede those specifically addressed by SAE Test Standards, nor of any regulatory agency that may have or exercise control over the covered activities.

2 Purpose

The purpose of this procedure is to provide guidance on testing the susceptibility to and potential of generating electromagnetic interference for the electric pushback tractor is being subjected to the eGSEV America Performance Test Program. 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, as appropriate. This testing and data acquisition meets the requirements specified in the eGSEV America Technical Requirements.

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-GAC004, "Review of Test Results." Storage and retention of records during and following testing activities shall be completed as described in ETA-GAC001, "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 appropriate Test Data Sheet.

- 4.1 Personnel conducting testing under this procedure shall be familiar with the requirements of this procedure, and when applicable, the appropriate SAE test instructions, administrative control procedures, and be certified by the Program Manager, Test Director, or Test Manager prior to commencing any testing activities.
- 4.2 Ambient temperature during testing shall be $>40^{\circ}\text{F}$ ($>5^{\circ}\text{C}$).
- 4.3 Vehicles shall be tested in their normal configuration with normal standard equipment, appendages, and accessories.

- 4.4 Accessories not required for safe operation shall not be used or operated during testing, except as specified by a test procedure.
- 4.5 For tests requiring a battery at X% SOC at the start of testing, the required initial SOC will be established as follows:
 - 4.5.1 The battery shall be fully charged to the requirements of the battery supplier until the battery is at 100% SOC (GTP-005, "Battery Charger Performance", Section 5.6).
 - 4.5.2 The battery energy capacity shall be obtained from the battery capacity test completed as part of ETA-GTP003, "Battery Capacity and Depth of Discharge Test."
 - 4.5.3 To achieve X% SOC, the battery will be discharged by operating the vehicle at the test location until 1-X% capacity, measured in ampere-hours or kilowatt-hours, have been removed from the battery. If operation of the vehicle to discharge the battery as required is not practical, another suitable method of discharging the battery will be determined and approved by the Program Manager.
 - 4.5.4 Tests conducted with the battery partially discharged at the test start should be initiated no more than 10 minutes after the desired initial state-of-discharge is reached.
- 4.6 The overall error of recording or indicating instruments shall not exceed $\pm 2\%$ of the maximum value of the attribute being measured. Periodic calibration shall be performed and documented to ensure compliance with this requirement.
- 4.7 Complete or verify completed procedures ETA-GTP001, "Vehicle Verification," and ETA-GAC006, "Receipt Inspection," for the vehicle being tested.
- 4.8 For instrumentation used in the test, at a minimum, record the following information for each instrument in Appendix B:
 - 4.8.1 Supplier
 - 4.8.2 Model number
 - 4.8.3 Serial number
 - 4.8.4 Last calibration date
 - 4.8.5 Next calibration date.
- 4.9 Any deviation from the test procedure and the reason for the deviation shall be recorded in accordance with ETA-GAC002, "Control of Test Conduct."

- 4.10 Speed-time measuring devices and other necessary equipment shall be installed in a manner that does not hinder vehicle operation or alter the operating characteristics of the vehicle.
- 4.11 All steps shall be completed in the order written. Deviations from any step or requirement must have the prior written approval of the Program Manager, Test Director or Test Manager in accordance with ETA-GAC002.
- 4.12 All documentation required to complete the testing identified in the contract/proposal/technical guidelines shall be completed, approved and issued prior to the effective date of the procedure. In no case shall the procedure be utilized for official testing or data collection prior to its effective date.
- 4.13 Testing MAY take place over the course of several days. Page 1 of Appendix A shall be completed for each day testing is commenced.

5 Testing Activity

These tests determine the susceptibility to and source of electromagnetic interference as required by the eGSEV America Technical Specification.

5.1 Test Preparation

- 5.1.1 This test is to be conducted in conjunction with ETA-GTP002, Section 5.4.2, "Static Drawbar Test."
- 5.1.2 Required equipment includes the following:
 - 5.1.2.1 One pair of 2-way radios (as commonly used by airport personnel)
 - 5.1.2.2 AM/FM radio
 - 5.1.2.3 Cellular phone.

5.2 Ambient Conditions

Record the following environmental conditions in Appendix A:

- 5.2.1 Range of ambient temperature during the test
- 5.2.2 Precipitation.

5.3 Electromagnetic Susceptibility

5.3.1 The following devices shall be operated during the conduct of the “Static Drawbar” test to determine if the any impact on the vehicle system can be detected. The devices should be operated at various locations around the perimeter of the tractor:

5.3.1.1 Two-way radio

5.3.1.2 A cellular telephone.

5.3.2 Record any impact to the vehicle in Appendix A.

5.4 Radio Frequency Interference

5.4.1 During the conduct of the “Static Drawbar” test in accordance with ETA-GTP002, Section 5.4.2, operate the following equipment, both inside and outside the tractor, to determine if any interference is being generated from the vehicle:

5.4.1.1 Cellular telephone

5.4.1.2 Two-way radio.

Devices and /or their antennae shall be located in a manner to maximize their potential for interference. (Prior to testing the initial vehicle, these devices shall be operated in the test area to verify there is no background interference.)

5.4.2 Device operation and any interference noted shall be recorded in Appendix B.

6 Glossary

- 6.1 Effective Date - After a procedure has been reviewed and approved, the first date the procedure can be utilized for official data collection and testing.
- 6.2 Fifth Wheel - A calibrated mechanical instrument used to measure a vehicle's speed and distance independent of the vehicle's onboard systems.
- 6.3 Initial Conditions - Conditions that must exist prior to an event occurring.
- 6.4 Initial State of Charge (SOC) - The residual capacity of a battery after a discharge (full or partial) expressed as a percent of the total battery energy capacity. This may be portrayed in ampere-hours, miles, or kilowatt-hours. Initial state of charge is the SOC at the beginning of a test.
- 6.5 Prerequisites - Requirements that must be met or resolved prior to an event occurring.
- 6.6 Program Manager - As used in this procedure, the individual within Electric Transportation Applications responsible for oversight of the NEV America Performance Test Program. [Subcontract organizations may have similarly titled individuals, but they are not addressed by this procedure.]
- 6.7 Shall - This word is used to indicate an item that requires adherence without deviation. Shall statements identify binding requirements. A go, no-go criterion.
- 6.8 Should - This word is used to identify an item that requires adherence if at all possible. Should statements identify preferred conditions.
- 6.9 Summary Data Sheet - A stylized presentation of test results in the form shown in ETGA-GTP003 Revision 0, Appendix A.
- 6.10 Test Director - The individual within Electric Transportation Applications responsible for all testing activities associated with the NEV America Performance Test Program.
- 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 implementation of the test program for any given vehicle(s) being evaluated to the requirements of the NEV America Performance Test Program. [Subcontract organizations may have similarly titled individuals, but they are not addressed by this procedure.]

7 References

eGSEV America Vehicle Technical Specification Revision 0, December 1, 2005

ETA-GAC001, "Control, Close-out and Storage of Documentation"

ETA-GAC002, "Control of Test Conduct"

ETA-GAC004, "Review of Test Results"

ETA-GAC006, "Receipt Inspection"

ETA-GTP001, "Vehicle Verification"

ETA-GTP002, "Traction System Test"

ETA-GTP003, "Battery Capacity and Depth of Discharge Test"

ETA-GTP005, "Battery Charger Performance"

Appendix A, Electromagnetic Interference and Susceptibility Data Sheet

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Vehicle Number: _____

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

Track/Weather Conditions

Test Location:	
Ambient Temperature (initial):	Ambient Temperature (final):
(≥40°F or 5°C)	(≥40°F or 5°C)
General Conditions (initial):	General Conditions (completion):

Appendix B, Vehicle Metrology Setup Sheets

(Page 1 of 1)

Vehicle Number: _____

Instrument/Device:	Calibration Due Date:	Initials / Date:
Fifth Wheel S/N:		
Fifth Wheel Calibrator S/N:		
DAQ S/N:		
DAQ Set-up Sheet S/N:		
kWh Meter S/N:		
Shunt S/N:		
Tire Pressure Gauge S/N:		
Accelerometer:		
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>