ETA-NTP002

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Implementation of SAE Standard J1666 May93

Electric Vehicle Acceleration, Gradeability, and Deceleration Test Procedure

Prepared by

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1.0 Objective

The objective of this procedure is to identify proper methods for the control of testing activities pursuant to the requirements of SAE J1666, "Electric Vehicle Acceleration, Gradeability and Deceleration Test Procedure." These methods are not meant to supersede those of the testing facility, those specifically addressed by SAE Test Standards, nor of any regulatory agency who may have or exercise control over the covered activities.

2.0 Purpose

The purpose of this procedure is to identify acceptable methods for the implementation of the test requirements of SAE Standard J1666. The SAE-J1666 Recommended Practice establishes uniform procedures for testing electric battery-powered vehicles as a total system rather than its individuals subsystems. This procedure collects and retains test data as specified in the "NEV America Vehicle Technical Specification."

3.0 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-NAC004, "Review of Test Results." Storage and retention of records during and following testing activities shall be completed as described in Procedure ETA-NAC001, "Control, Close-out and Storage of Documentation."

4.0 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 should be verified as complete and recorded on the Test Data Sheet.

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

4.2 Ambient temperatures during testing shall be within the range required by the specific test section(s).

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4.3 Road Testing

4.3.1 Acceleration tests will be performed on a road or closed track which is level to within 1% (±0.5%).

4.3.2 Tests shall be run in opposite directions when they are performed on a road test route.

4.3.3 The direction of travel need not be reversed when operating on a closed test track.

4.3.4 Battery temperatures at the beginning of the test shall be between 59˚F and 100˚F (15˚C to 38˚C).

4.3.5 Ambient temperature during road testing shall be within the range of 40˚F to 120˚F (5˚C to 49˚C).

4.3.6 The recorded average wind speed at the test site during the test shall not exceed 10 mph (16 km/h).

4.4 Vehicle shall be tested in its normal configuration with normal appendages (mirrors, bumpers, hubcaps, etc.). Certain items (hub caps, etc.) may be removed where necessary for safety on the dynamometer.

4.5 Vehicles shall be tested at curb weight plus 332 pounds. Consideration should be given to how adding instrumentation will affect the test weight and balance of the vehicle.

4.6 Manufacturers recommended tires shall be used.

4.7 Normal manufacturer's recommended lubricants shall be employed.

4.8 Accessories shall not be used during testing.

4.9 Full charge is to be established using the manufacturer's recommended charging procedure and equipment in accordance with ETA-NTP008, “Battery Charging.”

4.10 For tests requiring a battery at X% SOC at the start of testing, the required initial SOC will be established as follows:

4.10.1 The battery shall be fully charged to the requirements of the vehicle manufacturer until the battery is at 100% State of Charge.

4.10.2 The battery capacity (mileage based) shall be obtained from the 25 mph Constant Speed Range Test completed as part of ETA-NTP004, “Constant Speed Range Tests.”

4.10.3 To achieve X% SOC, the battery shall be discharged, by driving the vehicle on a test track at a constant speed of 25 mph until Y% capacity, measured in ampere-hours, kilowatt-hours or miles, has been removed from the battery. [Where X+Y = 100% capacity]

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4.10.4 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. **This is a deviation from SAE J1666.**

4.11 For tests in which the effects of battery initial SOC are to be investigated, tests shall be conducted with the traction batteries at SOCs of 90% ±10% and 50% ±10%, or as noted in the individual test section.

4.12 The following data shall be collected during conduct of the various tests specified by this procedure. Overall error in recording or indicating instruments shall not exceed ±2% of the maximum value of the variable being measured, unless otherwise excepted and noted. Periodic calibration shall be performed and documented to ensure compliance with this requirement.

4.12.1 Battery voltage versus time;

4.12.2 Battery current versus time;

4.12.3 Vehicle speed vs. time;

4.12.4 Distance Vs time;

4.12.5 Battery temperature Vs time;

4.12.6 Battery power versus time;

4.13 Environmental conditions during the testing shall be recorded and include, at a minimum, the following:

4.13.1 Range of ambient temperature during the test;

4.13.2 Range of wind velocity during the test;

4.13.3 Range of wind direction during the test.

4.14 The running surface upon which the test is being conducted shall be noted.

4.15 A description of the test route, road surface type and condition (SAE J688, "Truck Ability Prediction Procedure") and lengths and grades of test route, shall be recorded.

4.16 The date and starting and ending times of test shall be recorded.

4.17 All instrumentation used in the test shall be listed on Appendix D and attached to the test data sheets/results and shall include the following information:

4.17.1 Manufacturer

4.17.2 Model Number

4.17.3 Serial Number

4.17.4 Last Calibration date

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4.17.5 Next Calibration date

4.20 Any deviation from the test procedure and the reason for the deviation, shall be recorded in accordance with ETA-NAC002, "Test Conduct."

4.21 The speed-time measuring device and other necessary equipment shall be installed so that they do not hinder vehicle operation or alter the operating characteristics of the vehicle.

4.22 All documentation required to complete testing shall be completed, approved and ready for issue prior to commencing the testing it addresses.

4.23 Complete or verify complete procedure ETA-NAC006, "Vehicle Verification," and ETA-NTP011, "Receipt Inspection," for the vehicle being tested.

5.0 Test Activity Requirements

This section addresses all of the test types required to meet the stated purpose and objectives of this procedure. To this end, it selectively implements portions of SAE J1666. For ease of use and consistency of format with other Test Procedures, this section is divided into subsections for the Major Test Sections. Unless otherwise noted, each section may be completed independent of all the other sections.

NOTE

Activities necessary to complete the test are identified in the following sections. All items shall be completed, whether they are required by J1666 or not. Any section which cannot be completed shall be so annotated, along with the appropriate justification in accordance with ETA-NAC002, "Control of Test Conduct," on Appendix A.

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NOTE

The following sections may be completed in any order. However, the steps within each section shall be completed in the order written. Deviations shall have the approval of the Program Manager or Test Manager in accordance with ETA-NAC002, "Control of Test Conduct."

NOTE

Vehicle odometer readings shall be recorded within the appropriate test appendices upon initiation and completion of testing.

5.1 Vehicle Acceleration To Maximum Attainable Speed

NOTE

Vehicles should have a 0-20 mph acceleration time of 6.0 seconds or less when loaded with two 166-pound occupants at 50 % State of Charge.

NOTE

In this section, vehicles will be tested a minimum of four times (twice at an SOC/effective mileage of 90% ±10%, and twice at an SOC/effective mileage of 50% ±10%).

5.1.1 Record data and results on Appendix A.

5.1.2 Determine the speed to be achieved, and record on Appendix A.

5.1.3 Vehicle shall be instrumented to obtain, at a minimum, the data identified in Section 4.13.

5.1.4 Verify the traction battery is fully charged (90% ± 10% SOC prior to completion of the final last run). Record on Appendix A.

NOTE

The last 3000 feet of the track for this test shall be straightaway.

5.1.5 Ensure the vehicle is weighted to curb weight plus 332 pounds. This shall include the driver.

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5.1.6 From a standing start, accelerate the vehicle at its maximum attainable acceleration or the manufacturer's maximum permissible acceleration rate(s) (whichever is less) until the vehicle has achieved it's maximum attainable speed, and continue until the vehicle has traveled at least one mile. Note the speed achieved and the time required to achieve it on Appendix A. [If the data is being accumulated into a DAS, this data may be transcribed subsequent to the data download.]

5.1.7 The maximum time interval between the completion of the acceleration portion of one run to the beginning of the next successive run shall not exceed 5 minutes. Record elapsed time on Appendix A. [If the data is being accumulated into a DAS, this time interval may be transcribed subsequent to the data download.]

5.1.8 Reverse the direction of travel on the test track.

5.1.9 From a standing start, accelerate the vehicle at its maximum attainable acceleration or the manufacturer's maximum permissible acceleration rate(s) (whichever is less) until the vehicle has achieved it's maximum attainable speed, and continue until the vehicle has traveled at least one mile. Note the speed achieved and the time required to achieve it on Appendix A. [If the data is being accumulated into a DAS, this data may be transcribed subsequent to the data download.]

5.1.10 Record completion of this test portion on Appendix A.

5.1.11 Charge/discharge the traction battery to achieve a SOC of 50% ±10%. Record on Appendix A.

5.1.12 From a standing start, accelerate the vehicle at its maximum attainable acceleration or the manufacturer's maximum permissible acceleration rate(s) (whichever is less) until the vehicle has achieved it's maximum attainable speed, and continue until the vehicle has traveled at least one mile. Note the speed achieved and the time required to achieve it on Appendix A. [If the data is being accumulated into a DAS, this data may be transcribed subsequent to the data download.]

5.1.13 The maximum time interval between the completion of the acceleration portion of one run to the beginning of the next successive run shall not exceed 5 minutes. Record elapsed time on Appendix A. [If the data is being accumulated into a DAS, this time interval may be transcribed subsequent to the data download.]

5.1.14 Reverse the direction of travel on the test track.

5.1.15 From a standing start, accelerate the vehicle at its maximum attainable acceleration or the manufacturer's maximum

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permissible acceleration rate(s) (whichever is less) until the vehicle has achieved it's maximum attainable speed, and continue until the vehicle has traveled at least one mile. Note the speed achieved and the time required to achieve it on Appendix A. [If the data is being accumulated into a DAS, this data may be transcribed subsequent to the data download.]

5.1.16 Record completion of this test section on Appendix A.

5.2 Maximum Speed Test at FMVSS Weights (49CFR571.500)

NOTE

This test is completed for the sole purpose of satisfying the requirements of 49CFR571.500.S5(a), which states: "When tested in accordance with test conditions in S6 and test procedures in S7, the maximum speed attainable in 1.6 km (1 mile) by each low-speed vehicle shall be not more than 40 kilometers per hour (25 miles per hour)."

NOTE

The weight requirement for this test is curb weight plus 170 lbs., which differs from the weight in Section 5.1.

5.2.1 Record the vehicle being tested on Appendix A.

5.2.2 Determine the speed to be achieved, and record on Appendix A.

5.2.3 Vehicle shall be instrumented to obtain, at a minimum, the data identified in Section 4.13.

5.2.4 Verify the traction battery is fully charged (not less than 95% SOC). Record on Appendix A.

NOTE

The last 3000 feet of the track for this test shall be straightaway.

5.2.5 Ensure the vehicle is weighted to curb weight plus 170 pounds. This shall include the driver.

5.2.6 From a standing start, accelerate the vehicle at its maximum attainable acceleration or the manufacturer's maximum permissible acceleration rate(s) (whichever is less) until the vehicle has achieved it's maximum attainable speed, and continue until the vehicle has traveled at least one mile. Note the speed achieved and the time required to achieve it on Appendix A. [If the data is being

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accumulated into a DAS, this data may be transcribed subsequent to the data download.]

5.2.7 The maximum time interval between the completion of the acceleration portion of one run to the beginning of the next successive run shall not exceed 30 minutes. Record elapsed time on Appendix A. [If the data is being accumulated into a DAS, this time interval may be transcribed subsequent to the data download.]

5.2.8 Reverse the direction of travel on the test track.

5.2.9 From a standing start, accelerate the vehicle at its maximum attainable acceleration or the manufacturer's maximum permissible acceleration rate(s) (whichever is less) until the vehicle has achieved it's maximum attainable speed, and continue until the vehicle has traveled at least one mile. Note the speed achieved and the time required to achieve it on Appendix A. [If the data is being accumulated into a DAS, this data may be transcribed subsequent to the data download.]

5.2.10 Record completion of this test portion on Appendix A.

5.3 Gradeability Limit by Test

The purpose of this test is to determine the maximum grade on which the vehicles can move forward. Vehicles should be capable of starting and ascending a 25% grade when loaded with two 166-pound occupants at 50% SOC. Because it is impractical to obtain direct measurement of gradeability limit on steep test grades, the gradeability limit is to be calculated using the vehicle's measured receipt curb weight plus 332 pounds and the measured tractive force delivered by the vehicle at a speed near zero. **This is a deviation from SAE J1666.**

This test shall be performed with the vehicle at curb weight plus 332 pounds. If the traction force is limited by slippage between the drive wheels and the road surface, this should be noted.

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The percent gradeability limit shall be determined using the following relationship:

$$\text{Percent Gradeability Limit} = 100 \tan\left(\sin^{-1}\frac{P}{W}\right) \qquad \textit{Eq.1}$$

Where: P = Measured traction force, lb
W = Curb Weight plus 332 pounds, lb

5.3.1 Attach the test vehicle to a mass that can be dragged at low speed. Adjust the mass or road friction such that the test vehicle is capable of dragging the mass at approximately 2 mph while at full power. Instrument the connection between the vehicle and the mass with a force gauge capable of reading at least 3000 pounds force with an accuracy of ±2%.

5.3.2 The vehicle shall be weighted at curb weight plus 332 pounds. Record on Appendix B.

5.3.3 Charge/discharge the traction batteries to achieve a SOC of 50% ±10%. Record on Appendix B.

5.3.4 The tractive force shall be measured with the vehicle on a level grade road surface. Record the percent grade on Appendix B.

5.3.5 Record the maximum force the vehicle's propulsion system can maintain for a period of 20 seconds while moving the vehicle at a minimum speed of 1 mph (1.5 km/h) on Appendix B.

5.3.6 Record test section completion on Appendix B.

5.4 Gradeability Limit by Analysis

The purpose of this test is to determine the maximum grade on which the vehicles can move forward. Because the discharge rates associated with the constant low speed pulls are high, it is possible to obtain gradeability limits which are lower than what might actually be experienced by a vehicle operator. An alternative method is to determine the tractive force from the data obtained during the maximum acceleration tests. After calculating this force, implement this value into *Eq. 1* to calculate the maximum gradeability.

5.4.1 Determine the maximum acceleration value from Section 5.1 of this procedure.

5.4.2 Obtain the vehicle weight value used during Section 5.1 of this procedure.

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5.4.3 Using the formula:

Force = (mass) x (acceleration) *Eq. 2*

determine the maximum force available.

5.4.4 Insert this value into Eq. 1, as value P

5.4.5 Solve for the Maximum Gradeability Limit and record on the comments section of Apppendix B

5.5 Gradeability at Speed

This test determines the maximum speed which can be achieved on roads with 3% and 6% grades at a battery SOC of 50% ±10%. Vehicles should achieve a minimum sustainable speed of 20 mph when loaded with two 166-pound occupants on a 6% grade with batteries at 50% SOC.

5.5.1 Using the speed-time data from the road tests of section 5.1 completed at an SOC of 50% ±10%, the vehicle's acceleration characteristics shall be plotted. Data for successive time intervals are to be used to determine the vehicles average acceleration during the nth time interval

$$\bar{a}_n = (V_n - V_{n-1})/t_n - t_{n-1} \qquad \textit{Eq. 3}$$

when the vehicle has reached the average speed,

$$\bar{V} = (V_n + V_{n-1})/2 \qquad \textit{Eq. 4}$$

The data derived from these calculations shall be plotted as average acceleration versus speed as a smooth curve through the calculated points for an SOC of 50% ±10%. (If the vehicle was equipped with a recording accelerometer, the acceleration curve information shall be obtained directly.) The percent grade the vehicle is able to traverse at any selected speed shall now be calculated using the following relationship:

Percent Gradeability at Speed = 100 tan ($\sin^{-1}$ 0.0455a) *Eq. 5*

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where:

a = Vehicle acceleration at the selected speed, mph/s

(The constant 0.0455 in this equation becomes 0.0283 when acceleration is in units of km/h-s.)

5.5.2 Determine maximum speed for grades of 3% and 6%, documenting calculations and results on Appendix C.

6.0 Data Reduction and Acceptability Criteria

6.1 The requirements for data reduction are specifically addressed in Section 9 of SAE J1263, May91. Refer to that standard for these techniques.

6.2 Acceptability requirements are presented in Section 9.4 of SAE J1634 May93.

6.3 Distribution, retention and destruction of all test documents shall be in accordance with the requirements identified in Procedure ETA-NAC001, "Control, Close-out and Storage of Documentation."

6.4 Compliance with the 25 mile per hour limit, as tested in section 5.2, shall be determined by averaging vehicle speed using a 10 second rolling average, the value of which shall at no time exceed 25.99 mph.

7.0 Glossary

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7.1 Battery Kilowatt-Hour Capacity - The capacity of a battery in kilowatt-hours determined as a function of the total distance traveled by the vehicle during performance of the 20 mph Constant Speed Range Test portion of ETA-TP004, "Electric Vehicle Range at Steady Speed."

7.2 Cut-Off Terminal Voltage - The manufacturer-recommended minimum voltage as a function of load after which battery damage could occur.

7.3 Depth of Discharge (DOD) - The quantified percentage of discharge of a battery, in terms of ampere-hours, kilowatt-hours or miles, expressed as a percentage of the total battery capacity in similar units.

7.4 Effective Date - The date, after which a procedure has been reviewed and approved, that the procedure can be utilized in the field for official testing.

7.5 Fifth Wheel - A calibrated mechanical instrument used to measure a vehicle's speed and distance independent of the vehicles on-board systems.

7.6 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.

7.17 Gross Vehicle Weight Rating - The maximum design loaded weight of the vehicle specified by the manufacturer.

7.8 Initial Conditions - Conditions that shall exist prior to an event occurring.

7.9 Prerequisites - Requirements that shall be met or resolved prior to an event occurring.

7.10 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.]

7.11 Shall - Items which require adherence without deviation. Shall statements identify binding requirements. A go, no-go criterion.

7.12 Should - Items which require adherence if at all possible. Should statements identify preferred conditions.

7.13 State of Charge (SOC) - For this testing, the SOC of a battery is defined as the expected residual battery capacity, expressed in amperes-hours or watt-hours or miles, 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 main propulsion battery when discharged to the requirements of the 20 mph Constant Speed Range Test portion of procedure ETA-NTP004.

7.14 Test Director - The individual within Electric Transportation Applications responsible for all testing activities associated with the NEV America Performance Test Program.

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7.15 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.

7.16 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.]

7.17 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 the NEV America Performance Test Program. [Subcontract organizations may have similarly titled individuals, but they are not addressed by this procedure.]

7.18 Test Mass [Weight] - The mass [weight] of the vehicle as tested; including driver, operator (if necessary) and all instrumentation.

7.19 Tractive Force - The force available from the driving wheels at the driving wheel/ground interface.

8.0 References

8.1 SAE Recommended Practice - "Road Load Measurement and Dynamometer Simulation Using Coastdown Techniques" - SAE J1263 Jun91"

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8.2 SAE Recommended Practice - "Electric Vehicle Acceleration, Gradeability, and Deceleration Test Procedure" SAE J1666, May93

8.3 NEV America Vehicle Technical Specification
Revision 1, April 15, 2002

8.4 ETA-NAC001, "Control, Close-out and Storage of Documentation"

8.5 ETA-NAC002, "Control of Test Conduct"

8.6 ETA-NAC004, "Review of Test Results"

8.7 ETA-NAC005, "Qualification, Certification & Training of Test Personnel"

8.8 ETA-NAC006, "Vehicle Verification"

8.9 ETA-NAC007, "Control of Measuring and Test Equipment"

8.10 ETA-NTP004, "Constant Speed Range Test"

8.11 ETA-NTP005, "Electric Vehicle Rough Road Course Test"

8.12 ETA-NTP008, "Battery Charging"

8.13 ETA-NTP011, "Receipt Inspection"

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APPENDIX-A
Electric Vehicle Acceleration to Maximum Attainable Speed Test Data Sheet
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Vehicle 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: (lbs or kg)	Right Front: (lbs or kg)	Total Front: (lbs or kg)	Percent Front: %
Left Rear: (lbs or kg)	Right Rear: (lbs or kg)	Total Rear: (lbs or kg)	Percent Rear: %
		Total Weight: (lbs or kg)	

INSTALLED TIRES (Placard or sidewall whichever is less)			
Preparation Area Temperature: °F (or °C)			
Left Front		Right Front	
Pressure: (psi or kPa)		Pressure: (psi or kPa)	
Left Rear		Right Rear	
Pressure: (psi or kPa)		Pressure: (psi or kPa)	

Track/Weather Conditions

Test Track Location:	Track Grade: % (Within 1%)
Ambient Temperature (initial): (40-90°F or 5-32°C)	Ambient Temperature (final): (40-90°F or 5-32°C)
Track Temperature (initial): (°F or °C)	Track Temperature (final): (°F or °C)
Wind Velocity (initial): (<10 mph or 16 km/h)	Wind Velocity (final): (<10 mph or 16 km/h)
Wind Direction (initial): °	Wind Direction (completion): °

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APPENDIX-A
Electric Vehicle Acceleration to Maximum Attainable Speed Test Data Sheet
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Test Data Sheet (Maximum Attainable Speed with battery at 90% ±10% SOC)

Sequence No: 1	File No.:	Direction of Travel:
Time (initial):	Time (final):	
Odometer (initial): (miles or kilometers)	Odometer (final): (miles or kilometers)	
Status of Charge (initial): (SOC; kWh; Ah)	Status of Charge (final): (SOC; kWh; Ah)	
Battery Temp (initial): (°F or °C)	Battery Temp (final): (°F or °C)	
Comments (initials/date): *Note: Vehicles should have a 0-20 mph acceleration time of 6.0 sec or less when loaded with two 166 pound occupants* *Note: Maximum time between runs is 5 minutes.*		

Sequence No: 2	File No.:	Direction of Travel:
Time (initial):	Time (final):	
Odometer (initial): (miles or kilometers)	Odometer (final): (miles or kilometers)	
Status of Charge (initial): (SOC; kWh; Ah)	Status of Charge (final): (SOC; kWh; Ah)	
Battery Temp (initial): (°F or °C)	Battery Temp (final): (°F or °C)	
Comments (initials/date): *Note: Vehicles should have a 0-20 mph acceleration time of 6.0 sec or less when loaded with two 166 pound occupants*		

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Electric Vehicle Acceleration to Maximum Attainable Speed Test Data Sheet
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Test Data Sheet (Maximum Attainable Speed with battery at 50% ±10% SOC)

Sequence No: 3	File No.:	Direction of Travel:
Time (initial):	Time (final):	
Odometer (initial): (miles or kilometers)	Odometer (final): (miles or kilometers)	
Status of Charge (initial): (SOC; kWh; Ah)	Status of Charge (final): (SOC; kWh; Ah)	
Battery Temp (initial): (°F or °C)	Battery Temp (final): (°F or °C)	
Comments (initials/date): *Note: Vehicles should have a 0-20 mph acceleration time of 6.0 sec or less when loaded with two 166 pound occupants* *Note: Maximum time between runs is 5 minutes*		

Sequence No: 4	File No.:	Direction of Travel:
Time (initial):	Time (final):	
Odometer (initial): (miles or kilometers)	Odometer (final): (miles or kilometers)	
Status of Charge (initial): (SOC; kWh; Ah)	Status of Charge (final): (SOC; kWh; Ah)	
Battery Temp (initial): (°F or °C)	Battery Temp (final): (°F or °C)	
Comments (initials/date): *Note: Vehicles should have a 0-20 mph acceleration time of 6.0 sec or less when loaded with two 166 pound occupants*		

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APPENDIX-A
Electric Vehicle Acceleration to Maximum Attainable Speed Test Data Sheet
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Test Data Sheet (Maximum Attainable Speed with battery at ≥95% SOC)

Sequence No: 1	File No.:	Direction of Travel:
Time (initial):	Time (final):	
Odometer (initial): (miles or kilometers)	Odometer (final): (miles or kilometers)	
Status of Charge (initial): (SOC; kWh; Ah)	Status of Charge (final): (SOC; kWh; Ah)	
Battery Temp (initial): (°F or °C)	Battery Temp (final): (°F or °C)	
Comments (initials/date): *Note: Vehicles should have a maximum speed of 25 mph or less when loaded to curb weight plus 170 pound occupant* *Note: Maximum time between runs is 30 minutes*		

Sequence No: 2	File No.:	Direction of Travel:
Time (initial):	Time (final):	
Odometer (initial): (miles or kilometers)	Odometer (final): (miles or kilometers)	
Status of Charge (initial): (SOC; kWh; Ah)	Status of Charge (final): (SOC; kWh; Ah)	
Battery Temp (initial): (°F or °C)	Battery Temp (final): (°F or °C)	
Comments (initials/date): *Note: Vehicles should have a maximum speed of 25 mph or less when loaded to curb weight plus 170 pun occupant*		

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APPENDIX-A
Electric Vehicle Acceleration to Maximum Attainable Speed Test Data Sheet
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General Comments (initials/date):

Completed By:
(Printed Name) (Signature) (Date)

Reviewed By:
(Printed Name) (Signature) (Date)

Approved By:
(Printed Name) (Signature) (Date)

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APPENDIX-B
Electric Vehicle Gradeability Limit
Test Data Sheet
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Vehicle 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 (Rated vehicle GVWR)			
Left Front: (lbs or kg)	Right Front: (lbs or kg)	Total Front: (lbs or kg)	Percent Front: %
Left Rear: (lbs or kg)	Right Rear: (lbs or kg)	Total Rear: (lbs or kg)	Percent Rear: %
		Total Weight: (lbs or kg)	

INSTALLED TIRES (Placard or sidewall whichever is less)			
Preparation Area Temperature: °F (or °C)			
Left Front		Right Front	
Pressure: (psi or kPa)		Pressure: (psi or kPa)	
Left Rear		Right Rear	
Pressure: (psi or kPa)		Pressure: (psi or kPa)	

Track/Weather Conditions

Test Track Location:	Track Grade: % (Within 1%)
Ambient Temperature (initial): (40-90°F or 5-32°C)	Ambient Temperature (final): (40-90°F or 5-32°C)
Wind Velocity (initial): (<10 mph or 16 km/h)	Wind Velocity (final): (<10 mph or 16 km/h)
Wind Direction (initial): °	Wind Direction (completion): °

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APPENDIX-B
Electric Vehicle Gradeability Limit
Test Data Sheet
(Page 2 of 2)

Test Data Sheet (Gradeability Limit with battery at 50% ±10% SOC)

Sequence No: 1	File No.:	Direction of Travel:
Time (initial):	Time (final):	
Odometer (initial): (miles or kilometers)	Odometer (final): (miles or kilometers)	
Status of Charge (initial): (SOC; kWh; Ah)	Status of Charge (final): (SOC; kWh; Ah)	
Battery Temp (initial): (°F or °C)	Battery Temp (final): (°F or °C)	
Comments (initials/date): Force Reading: _____ Time Duration: _____ Vehicle Speed: _____		
Completed By: (Printed Name)	(Signature)	(Date)
Reviewed By: (Printed Name)	(Signature)	(Date)
Approved By: (Printed Name)	(Signature)	(Date)

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APPENDIX-C
Electric Vehicle Gradeability at Speed
Test Data Sheet
(Page 1 of 1)

Vehicle Number: _____

Speed Calculated for 3% Grade		
General Comments (initials/date):		
Speed Calculated for 6% Grade		
General Comments (initials/date):		
Completed By: (Printed Name)	(Signature)	(Date)
Reviewed By: (Printed Name)	(Signature)	(Date)
Approved By: (Printed Name)	(Signature)	(Date)

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APPENDIX-D
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: (Printed Name)	(Signature)	(Date)
Reviewed By (QA): (Printed Name)	(Signature)	(Date)

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