

ETA-UTP003

Revision 0

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Implementation of SAE J1634 May93 - “Electric Vehicle Energy Consumption and Range Test Procedure”

Prepared by

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1.0 Objective

The objective of this procedure is to identify the proper methods for the control of testing activities pursuant to the requirements of SAE Standard J1634, "Electric Vehicle Energy Consumption and Range Test Procedure." These methods are not meant to supersede those of the testing facility, those specifically addressed by SAE Test Standards (except as noted) 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-J1634. While the SAE-J1634 Recommended Practice establishes uniform procedures for testing electric battery-powered vehicles through the Urban Driving Schedule (UDS) and Highway Fuel Efficiency Tests (HWFET), this procedure establishes some requirements that are outside of the guidance of that SAE Standard. Additionally, this procedure authorizes deviations from some of the test requirements of the SAE J1634. These deviations are necessary to accomplish this test, and are clearly noted where they occur. This assures that relative performance between vehicles can be assessed.

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-UAC004, "Review of Test Results." Storage and retention of records during and following testing activities shall be completed as described in Procedure ETA-UAC001, "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 should 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 when applicable, the appropriate SAE Test Instructions, Administrative Control Procedures, and be certified by the Program Manager or the Test Manager/Engineer prior to commencing any testing activities.
- 4.2 Ambient temperatures during testing shall be $77^{\circ}\text{F} \pm 9^{\circ}\text{F}$.
- 4.3 Battery temperatures at the beginning of testing shall be less than 120°F , and should be less than 100°F .
- 4.4 Dynamometer Testing
 - 4.4.1 The load shall be programmable at various vehicle speeds to simulate vehicle road load versus speed characteristics.
 - 4.4.2 Road load power settings shall be made based on SAE J1263 as described in ETA-UTP001 and this procedure.
 - 4.4.3 Dynamometer flywheel shall be engaged with the nearest available dynamometer inertia weight which equals or exceeds Gross Vehicle Weight Rating (GVWR). Weights which exceed the GVWR by more than 2% will be approved by the Program Manager or Test Director, as appropriate.
 - 4.4.4 During dynamometer operation, a fixed speed cooling fan shall be positioned so as to direct cooling air to the front of the vehicle. The fan capacity in general shall not exceed $2.5 \text{ m}^3/\text{s}$ ($5300 \text{ ft}^3/\text{min}$). Auxiliary fans may be employed if needed to more closely duplicate on-road cooling conditions.
- 4.5 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.
- 4.6 During dynamometer testing, vehicles may use tires which have had the tread “shaved” off. This reduces tire heating, tire squirm and prevents absorption of road load by the tires. **This is a departure from the requirements of SAE J1634.**
- 4.7 Dynamometer tire pressure shall be set as required to achieve consistent testing results and repeatability through the coastdown cycles. This will nominally be 50 psig (cold inflation pressure).

This is different than the pressure used to establish the dynamometer road load power setting in ETA-UTP001. **This is a departure from the requirements of SAE J1634.**

- 4.8 Normal manufacturer's recommended lubricants shall be employed.
- 4.9 Prior to dynamometer testing, vehicles shall have accumulated a minimum of 100 miles (300 miles recommended) by completing the requirements of procedures ETA-UTP004 and ETA-UTP005. **This is a departure from the requirements of SAE J1634.**
- 4.10 Full charge should be established using the manufacturer's recommended charging procedure and equipment in accordance with ETA-UTP008, "Battery Charging."
- 4.11 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 $\pm 2\%$ of the maximum value of the variable being measured, or as specifically excepted elsewhere. Periodic calibration shall be performed and documented to ensure compliance with this requirement.
 - 4.11.1 Battery voltage versus time
 - 4.11.2 Battery current versus time
 - 4.11.3 Vehicle speed versus time
 - 4.11.4 Distance versus time
 - 4.11.5 Battery temperature versus time
 - 4.11.6 Battery power versus time
- 4.12 The range of ambient temperature during the testing shall be recorded.
- 4.13 A description of the dynamometer load program shall be recorded.
- 4.14 The date, starting and ending times shall be recorded.
- 4.15 The beginning and ending vehicle odometer readings shall be recorded.
- 4.14 All instrumentation used in the test shall be listed on Appendix A and attached to the test data sheets/results and shall include the following information:
 - 4.14.1 Manufacturer
 - 4.14.2 Model Number
 - 4.14.3 Serial Number
 - 4.14.4 Last Calibration date
 - 4.14.5 Next Calibration date

- 4.15 Any deviation from the test procedure and the reason for the deviation shall be recorded in accordance with ETA-UAC002, “Control of Test Conduct.”
- 4.16 The speed-time measuring device and other necessary equipment shall be installed so they do not hinder vehicle operation or alter the operating characteristics of the vehicle.
- 4.17 A description of the dynamometer shall be recorded, including:
 - 4.17.1 Drum or roll diameter and number of tire contact points
 - 4.17.2 Road load power set points
 - 4.17.3 Dynamometer inertia weight
 - 4.17.4 Vehicle speed from dynamometer roll
- 4.18 Accessories shall not be used during testing activities.
- 4.19 All documentation required to complete the testing shall be completed, approved and issued prior to commencing the testing it addresses.
- 4.20 A copy of test documentation and methodologies/instructions used for testing shall be included in the final test documentation program. This is in accordance with ETA-UAC002, “Control of Test Conduct.”
- 4.21 Verify that procedures ETA-UAC006, “Vehicle Verification,” and ETA-UTP011, “Receipt Inspection,” have been, or are being, completed.
- 4.22 Portions of procedure ETA-UTP009, “Measurement and Evaluation of Magnetic Fields Generated by Electric Vehicles,” shall be completed in conjunction with this procedure.

5.0 Dynamometer Setup

The purpose of this section is to prepare the dynamometer for use in testing electric vehicles to the requirements of SAE J1634 as required in Section 6.

CAUTION

The dynamometer is started and run in this procedure. ALL personnel shall exercise appropriate cautions while in the vicinity of both the Power Absorption Unit and the Roller Section.

NOTE

Activities necessary to complete the test are identified in the following sections. All items shall be completed, whether they are required by J1634 or not. Any section which cannot be completed shall be so annotated, along with the appropriate justification in accordance with ETA-UAC002, "Control of Test Conduct."

NOTE

For this test, vehicles shall be loaded at curb weight plus 332 pounds.

- 5.1 Start up the vibration monitor and control computer.
- 5.2 Conduct an initial warm-up of the dynamometer.
- 5.3 Conduct and complete the speed calibration of the dynamometer.
- 5.4 Conduct the Torque Calibration process for the dynamometer system.
- 5.5 Calibrate the Data Acquisition System (DAS) used in conjunction with the Dynamometer system.
- 5.6 Prepare the vehicle to be tested as follows:
 - 5.6.1 Verify the vehicle is weighted to curb weight plus 332 pounds (including the driver and test equipment).
 - 5.6.2 Install or verify that there are shaved tires installed on the test vehicle, as appropriate.
 - 5.6.3 Inflate the tires to a cold inflation pressure of 50 psig ± 0.5 psig. Record on Appendix B.
 - 5.6.4 Place the test vehicle on the dynamometer rollers, and center it on the rollers by slowly running it or turning the dynamometer rollers with the motor.
 - 5.6.5 If the vehicle will not center on the rollers, repeat step 5.6.4 until the vehicle is centered.

- 5.6.6 Place fan(s) in front of the vehicle and turn them on. Fans should be placed to simulate road air flow, not to exceed $2.5 \text{ m}^3/\text{s}$ ($5300 \text{ ft}^3/\text{min}$).
- 5.6.7 Attach tie-down straps to the vehicle.
- 5.6.8 Place wheel chocks at the non-driving wheels.

CAUTION

High Voltage may be present. To prevent personnel injury or equipment damage, use extreme caution when hooking up instrumentation leads.

- 5.6.9 Hook up vehicle instrumentation leads to the DAS.
- 5.7 Determination of Dynamometer and Tire Parasitic Losses
 - 5.7.1 Place the vehicle in neutral.
 - 5.7.2 Set the inertial weight to the lowest appropriate weight. Record the weight on Appendix B.
 - 5.7.3 Using the motor on the dynamometer, run the vehicle for a minimum of ten minutes for tire warm-up.
 - 5.7.4 Record the tire temperatures on Appendix B.
 - 5.7.5 Using the dynamometer motor, accelerate the vehicle to 63 mph.
 - 5.7.6 Shift to neutral and coast to 9 mph.
 - 5.7.7 Record the tire temperatures and parasitic loss coefficients on Appendix B.
 - 5.7.8 Save the data on the DAS.
 - 5.7.9 Repeat this test at each applicable inertial weight. Record the inertial weights used and the results of each run on Appendix B.
- 5.8 Set up the dynamometer to achieve the desired coast-down times.
 - 5.8.1 Determine the coastdown time in the 55-45 mph speed range using an initial estimate of the A and C coefficients.
 - 5.8.2 If measured coastdown times are not within 1.5% of the desired coastdown times, adjust A and C as necessary until three consecutive coastdown times fall into the 3% ($\pm 1.5\%$). Record the numerical results on Appendix B.
- 5.9 If the adjustment to A and C are greater than 3% from the initial calibration (the first time this procedure was conducted for the vehicle), an attempt to determine the cause of the “drift” should be

undertaken. This evaluation should include both the vehicle and the dynamometer.

6.0 Road Load Test Cycle

The purpose of this section is to determine the range achievable by an electric vehicle when subjected to the test schedules identified in SAE J1634. This section selectively implements portions of SAE J1634 in support of this purpose. The actual dynamometer instructions are developed by the entity operating the dynamometer and shall be used in conjunction with this procedure. As such, this procedure may be used at any facility utilizing a Clayton IM-240 Electric Dynamometer.

This procedure performs SAE Standard J1634 testing at an ambient temperature of $77^{\circ}\text{F} \pm 9^{\circ}\text{F}$. The load cycles shall follow the UDS road load schedule contained in SAE Standard J1634. Test room temperatures shall be controlled in accordance with existing facility instructions.

- 6.1 Conduct a warm-up of the dynamometer as follows:
 - 6.1.1 Verify that the proper inertia weight for the vehicle to be tested has been selected. Record this weight on Appendix C.
 - 6.1.2 Check the roller area and inform other people in the area that dynamometer operation is about to start.
 - 6.1.3 Verify that the rollers are clear of personnel and debris, cables, etc.
 - 6.1.4 Set the run time to at least 15 minutes and turn on the dynamometer motor. Monitor vibration levels for anomalies. Terminate operation if vibration levels exceed the manufacturer's/operator's recommended maximum or alert levels. Record the maximum allowable and achieved vibration levels on Appendix C.
- 6.2 Conduct a speed calibration of the dynamometer unit.
- 6.3 Conduct a torque calibration of the dynamometer and control system.
- 6.4 Conduct a calibration of the Data Acquisition System (DAS).
- 6.5 Conduct the SAE J1634 Road Load Simulation test as follows:
 - 6.5.1 Verify that the required ambient temperature in the test chamber has existed for at least 12 hours.
 - 6.5.2 Verify that the DAS instrumentation is connected.
 - 6.5.3 Verify the test vehicle has shaved tires installed with cold inflation tire pressures of $50 \text{ psig} \pm 0.5 \text{ psig}$. Record on Appendix C.
 - 6.5.4 Turn on the cooling fan(s).

- 6.5.5 Complete an initial tire warm-up for at least 15 minutes.
- 6.5.6 Enter the final A and C coefficients into the dynamometer control system. These were obtained in Step 5.8 of this procedure.
- 6.5.7 Record tire temperature on Appendix C.
- 6.5.8 Disconnect the vehicle from the charger.

NOTE

The SOC indicator reading shall be recorded at each significant datum (F, 1/2, 1/4, E, etc.).

- 6.5.9 Record traction battery SOC indicator reading on Appendix C.
- 6.5.10 The minimum traction battery voltage to be allowed during the test shall be obtained from ETA-UAC006, "Vehicle Verification." Record this value on Appendix C.
- 6.5.11 Record ambient temperature of test room on Appendix C.
- 6.5.12 Notify test vehicle driver that the test is about to begin.
- 6.5.13 Begin the test sequence of the SAE J1634 UDS Road Load Cycle.
- 6.5.14 Monitor the driver's performance and note the time, odometer reading, speed and distance at which an excursion from the drive cycle occurs, as well as the reason(s) for any such excursions on Appendix C.
- 6.5.15 Follow the Clayton software through both Urban Drive Cycles.
- 6.5.17 If the vehicle finishes the UDS cycles, complete the following:
 - 6.5.17.1 Turn off the fan(s)
 - 6.5.17.2 Turn off the ignition key
 - 6.5.17.3 Wait ten (10) minutes. Record the times on Appendix C.
 - 6.5.17.4 Take tire temperatures. Record on Appendix C.
- 6.5.18 Restart the Dynamometer Road Load test (two UDS cycles) at ten minutes after shut-down..

NOTE

Test termination criteria contained in SAE J1634 shall be the official method of determining vehicle distance traveled. However, this is not necessarily the criterion for terminating the test cycle. Testing shall be terminated based on traction battery voltage, or battery capacity as indicated by the sustained inability of the vehicle to attain or maintain speed, as opposed to the criteria contained in SAE J1634. **This is a deviation from the requirements of SAE J1634.**

- 6.5.19 Terminate the test based on the depletion of the vehicle batteries. Battery depletion shall be based on the manufacturer's specification of minimum voltage identified in ETA-UAC006, "Vehicle Verification," or by the Test Director or Test Manager.
- 6.5.20 Upon completion of the test, record the following on Appendix C:
 - 6.5.20.1 Time of day
 - 6.5.20.2 Test time
 - 6.5.20.3 Odometer reading
 - 6.5.20.4 Dynamometer distance
 - 6.5.20.5 Total distance
 - 6.5.20.6 Distance to SAE J1634 Cutoff criteria
 - 6.5.20.7 Final SOC indicator reading
 - 6.5.20.8 Final tire temperatures.
- 6.5.21 Remove the vehicle from the dynamometer.

NOTE

DC energy consumption may be calculated for the combined UDS-HWFET, a UDS cycle or a HWFET cycle. The equation is the same, but only the energy withdrawn during the test being evaluated should be used.

- 6.6 Calculate the DC energy consumption in Wh/mi delivered by the battery up to the point of test termination (where the test is officially terminated to the requirements of SAE J1634), using the following equation:
 - 6.6.1 Using the official mileage from the test cycle, complete the following calculation:

	DC Energy from Battery During
Cycle	

Vehicle DC Energy Consumption = -----

(with units of DC Wh/mile) Distance Traveled

- 6.6.2 The system AC energy consumption shall be completed in accordance with ETA-UTP008, "Battery Charging." **This is a departure from the requirements of SAE J1634.**

7.0 Data Reduction and Acceptability Criteria

- 7.1 The requirements for data reduction are specifically addressed in Section 10 of SAE J1263. Refer to that standard when clarification for utilizing these techniques is required.
- 7.2 Acceptability requirements are presented in Section 10.4 of SAE J1263.
- 7.3 Distribution, Retention and destruction of all test documents shall be in accordance with the requirements identified in Procedure ETA-UAC001, "Control, Close-out and Storage of Documentation."

8.0 Glossary

- 8.1 Data Reduction - The techniques for analyzing a set of coastdown data and the correction factors employed in the determination of the coefficients of the road load equation. These corrected coefficients are used to set up the dynamometer to match the 55-45 mph coastdown time targets.
- 8.2 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.
- 8.3 Effective Mass - The sum of the test mass and the effective inertia's of the driven and non-driven axles.
- 8.4 Gross Vehicle Weight Rating (GVWR) - The maximum design loaded weight of the vehicle specified by the manufacturer.
- 8.5 Initial Conditions - Conditions that must exist prior to an event occurring.
- 8.6 Prerequisites - Requirements that must be met or resolved prior to an event occurring.
- 8.7 Program Manager - As used in this procedure, the individual within Electric Transportation Applications responsible for oversight of the UEV America Performance Test Program. [Subcontract organizations may have similarly titled individuals, but they are not addressed by this procedure.]
- 8.8 Shall - Items which require adherence without deviation. Shall statements identify binding requirements. A go, no-go criterion.
- 8.9 Should - Items which require adherence if at all possible. Should statements identify preferred conditions.
- 8.10 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 35 mph Constant Speed Range Test portion of procedure ETA-UTP004.
- 8.11 Test Director - The individual within Electric Transportation Applications responsible for all testing activities associated with the UEV America Performance Test Program.
- 8.12 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.

8.0 Glossary (continued)

- 8.13 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.]
- 8.14 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 UEV America Performance Test Program. [Subcontract organizations may have similarly titled individuals, but they are not addressed by this procedure.]
- 8.15 Test Mass/Weight - The mass/weight of the vehicle as tested; including driver, operator (if necessary) and all instrumentation.

9.0 References

- 9.1 SAE Recommended Practice - "Road Load Measurement and Dynamometer Simulation Using Coastdown Techniques." - SAE J1263 Feb96
- 9.2 SAE Recommended Practice - "Electric Vehicle Energy Consumption and Range Test Procedure." SAE J1634, May93
- 9.3 UEV America Technical Specifications
- 9.4 ETA-UAC001, Revision 0 - "Control, Close-out and Storage of Documentation"
- 9.5 ETA-UAC002, Revision 0 - "Control of Test Conduct"
- 9.6 ETA-UAC004, Revision 0 - "Review of Test Results"
- 9.7 ETA-UAC005, Revision 0 - "Training and Certification Requirements For Personnel Utilizing ETA Procedures"
- 9.8 ETA-UAC006, Revision 0 - "Vehicle Verification"
- 9.9 ETA-UAC007, Revision 0 - "Control of Measuring and Test Equipment"
- 9.10 ETA-UTP001, Revision 0 - "Road Load Measurement and Dynamometer Simulation Using Coastdown Techniques"
- 9.11 ETA-UTP004, Revision 0 - "Electric Vehicle Range at Steady Speed Test"
- 9.12 ETA-UTP005, Revision 0 - "Electric Vehicle Rough Road Course Test"
- 9.13 ETA-UTP008, Revision 0- "Battery Charging"
- 9.14 ETA-UTP009, Revision 0 - "Measurement and Evaluation of Magnetic Fields Generated by Electric Vehicles",
- 9.15 ETA-UTP010, Revision 0 - "Battery Charger Test"
- 9.16 ETA-UTP011, Revision 0 - "Receipt Inspection"

APPENDIX-A
Electric Vehicle Metrology Setup Sheets
(Page 1 of 1)

Vehicle VIN: _____

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>

APPENDIX-B
SAE J1634 Test Data Sheet
(Page 1 of 3)

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: (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)
COLD (SHAVED) TIRE PRESSURE (50 psig \pm 0.5 psig)			
Left Front: (psig or kPa)		Right Front (psig or kPa)	
Left Rear (psig or kPa)		Right Rear psig or kPa (

Determination of Dynamometer and Tire Parasitic Losses

Inertial Weight Setting:				
TIRE WARM-UP TEMPERATURES				
Left Front: (°F or °C)		Right Front: (°F or °C)		
Left Rear: (°F or °C)		Right Rear: (°F or °C)		
Parasitic Loss - V _____				
	Base	_____	_____	_____
C1				
C2				
C3				
C4				
Tire Temperatures [°F]				
	Base	_____	_____	_____
Left				
Right				

**APPENDIX-B
SAE J1634 Test Data Sheet
(Page 2 of 3)**

VIN Number: _____

Repeatability: _____

Parasitic Loss -V _____				
	Base	_____	_____	_____
C1				
C2				
C3				
C4				
Tire Temperatures [°F]				
	Base	_____	_____	_____
Left				
Right				
Parasitic Loss -V _____				
	Base	_____	_____	_____
C1				
C2				
C3				
C4				
Tire Temperatures [°F]				
	Base	_____	_____	_____
Left				
Right				
Parasitic Loss -V _____				
	Base	_____	_____	_____
C1				
C2				
C3				
C4				
Tire Temperatures [°F]				
	Base	_____	_____	_____
Left				
Right				

APPENDIX-B
SAE J1634 Test Data Sheet
(Page 3 of 3)

VIN Number: _____

General Comments (initials/date):
[Large empty text area with horizontal lines for input]

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

**APPENDIX-C
SAE J1634 Road Test
Data Sheet (Page 1 of 2)**

VIN Number: _____

Inertial Weight Setting: <small>(lb)</small>		Maximum Allowable Vibration:	
TIRE PRESSURES (50 psig ±0.5 psig)			
Left Front: <small>(psig or kPa)</small>		Right Front <small>(psig or kPa)</small>	
Left Rear <small>(psig or kPa)</small>		Right Rear <small>(psig or kPa)</small>	
TIRE TEMPERATURES			
Left Front: <small>(°F or °C)</small>		Right Front: <small>(°F or °C)</small>	
Left Rear: <small>(°F or °C)</small>		Right Rear: <small>(°F or °C)</small>	
Traction Battery State of Charge:			
Minimum Allowable Traction Battery Voltage:			
Test Room Ambient Temperature: <small>(°F or °C)</small>			
EXCURSIONS FROM TEST CYCLE (see next page)			
Odometer Reading:		Time Waited:	
TIRE TEMPERATURES			
Left Front: <small>(°F or °C)</small>		Right Front: <small>(°F or °C)</small>	
Left Rear: <small>(°F or °C)</small>		Right Rear: <small>(°F or °C)</small>	
Time of Day:		Test Time:	
Odometer Reading:		Total Distance:	
FINAL TIRE TEMPERATURES			
Left Front: <small>(°F or °C)</small>		Right Front: <small>(°F or °C)</small>	
Left Rear: <small>(°F or °C)</small>		Right Rear: <small>(°F or °C)</small>	

Excursions from Drive Cycle:

Time:	Speed:	Distance:	Comments:	Initials:

APPENDIX-D
SAE J1634 Energy Efficiency Calculation Data Sheet (Page 1 of 1)

VIN Number: _____

AC into the Charger: <small>(kWh)</small>	DC into the battery: <small>(kWh)</small>
Calculations (initials/date): System DC Energy Consumption = $\frac{\text{DC Energy from Battery While Driving}}{\text{Distance Traveled}}$ System DC Energy Consumption = _____ = _____ (with units of DC Wh/mile)	
Completed By: (Printed Name)	(Signature) (Date)
Reviewed By: (Printed Name)	(Signature) (Date)
Approved By: (Printed Name)	(Signature) (Date)