Demonstration and Evaluation of U.S. Postal Service Electric Mail Delivery Vehicles

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I. INTRODUCTION

In December 1998 the Delivery and Customer Services Equipment Engineering division of the United States Postal Service (USPS) issued Specification USPS-E-PURC for the procurement of six Pilot Model [electric] vehicles “for examination and testing within the time frame specified by the Contraction Officer (CO), to prove that the production methods will produce methods will produce vehicles that meet the requirements specified herein”.

On December 22, 1999 the USPS announced that Ford had been selected to build the first 500 EVs of the demonstration program.

In April, 2000, the USPS and South Coast Air Quality Management District (AQMD) recognized Southern California Edison’s technical leadership position in the EV field and recommended that Baseline Performance and Accelerated Reliability Tests be performed at SCE’s Electric Vehicle Technical Center (EVTC) in Pomona, California, with oversight of the Department of Energy (DOE) Field Operations Program.

Under the terms of AQMD contract No. 00192, awarded on July 28th, 2000, SCE was to perform the following tasks:

- Task 1 – Baseline Performance Test Procedures Evaluation and Modification
- Task 2 – Accelerated Reliability Test Procedures Evaluation and Modification
- Task 3 – Conduct Baseline Performance Tests on two EVs
- Task 4 – Conduct Accelerated Reliability Tests on two EVs

Tasks number 1 and 2 were completed on August 10, 2000 when revision 0 of the Baseline Performance and Accelerated Reliability test Procedures were issued and forwarded to the USPS.

Tasks number 3 and 4 started on September 5, 2000 when SCE received USPS approval to operate the four vehicles delivered to the EVTC on July 5, 2000.

This quarterly progress report documents the test results as of October 31, 2000.

II. PURPOSE OF THE TESTS

- Baseline Performance Tests

The tests verify that the Pilot Model Vehicles conform to the performance related portions of the Specification USPS-E-PURC. These independent tests, combined with an inspection performed by USPS engineering personnel confirm that the vehicle designed and manufactured by the Ford Motor Company will be suitable for the intended demonstration program.

- Accelerated Reliability Tests

Long-term suitability for the USPS mail delivery mission are assessed by logging as many miles as reasonably possible with two vehicles over a period of one year. A minimum of 20,000 miles will be accumulated on each of the two EVs. The detailed and accurate documentation of the vehicle availability, operation and system's reliability is covered by these tests.

III. TEST RESULTS TO DATE

Baseline Performance

Acceleration, Maximum Speed, and Braking

USPS vehicles #1240003 and #1240004 (referred to as Vehicles #3 and #4) were tested at the Los Angeles River bed, which provided a smooth flat location for the various performance tests. Although these tests are usually performed at the Pomona Drag strip, this facility was not available during the testing time frame. As can be seen on the picture below (Figure 3-1), the LA River Bed provides ideal conditions for this type of testing. Other automotive test entities also use this facility to run similar performance tests. The Los Angeles County, on a special request basis, grants access to this facility.

Figure 3-1 Acceleration, Maximum Speed, and Braking Test Site

The test day was overcast with an average ambient temperature of 71^{o} F and wind gusts of approximately 5 mph.

A Vericom VC2000PC Performance Computer was used to measure the acceleration and braking performance of the vehicles. Runs were conducted at various states of charge and repeated twice in opposite directions to average the effects of wind and grade. Table 3-1, shows the acceleration and braking results for vehicle three and vehicle four, which were loaded at maximum payload (see Appendix D for a photo of the payload, 1000 lbs). The results used for the 15-35 and 25-55 mph tests were obtained by using a stopwatch and the vehicle’s speedometer.

Table 3-1 Performance Testing Data[1]

	USPS Minimum Requirements	100% SOC		80% SOC		60% SOC		40% SOC		20% SOC	
		Veh 3	Veh 4	Veh 3	Veh 4	Veh 3	Veh 4	Veh 3	Veh 4	Veh 3	Veh 4
0-15 mph (s)	5.00	2.89	2.92	2.89	*	2.88	2.85	2.90	2.90	2.91	2.93
0-50 mph (s)	22.00	17.35	17.68	18.24	*	16.88	16.11	18.04	16.94	17.87	17.60
15-35 mph (s)		6.04	5.93	5.95	*	6.67	6.14	6.48	5.80	*	5.86
25-55 mph (s)		17.20	15.98	17.17	*	18.48	16.23	18.72	17.32	*	17.05
Maximum Speed (mph)		61.5	65							62	63
					50% SOC						
					Veh 3	Veh 4					
Braking (20-0 mph) (ft.)	25.0				23.7	22.1					

[1] Average values recorded on 9-22-00 (average ambient temperature: 71°F). (1250 lb. Payload)

* Not tested because vehicle SOC dropped below test requirement.

Under the acceleration runs the vehicles produced a maximum current of 236.9 A, a maximum power of 67.7 kW, and a minimum pack voltage of 284 V when tested at 100% SOC. When tested at 20% SOC, the vehicles produced a maximum current of 264.8 A, a maximum power of 67.6 kW, and a minimum voltage of 252 V.

Under the acceleration tests, the vehicles demonstrated their ability to accelerate within the Post Office's minimum requirement of 22 seconds for 0-50 mph, and within 5 seconds for 0-15 mph. Figures 3-2 and 3-3 show the speed and distance profiles for vehicles three and four. These profiles show the time required to reach a given speed (15, 20, 50 and 55 mph are highlighted with dashed lines).

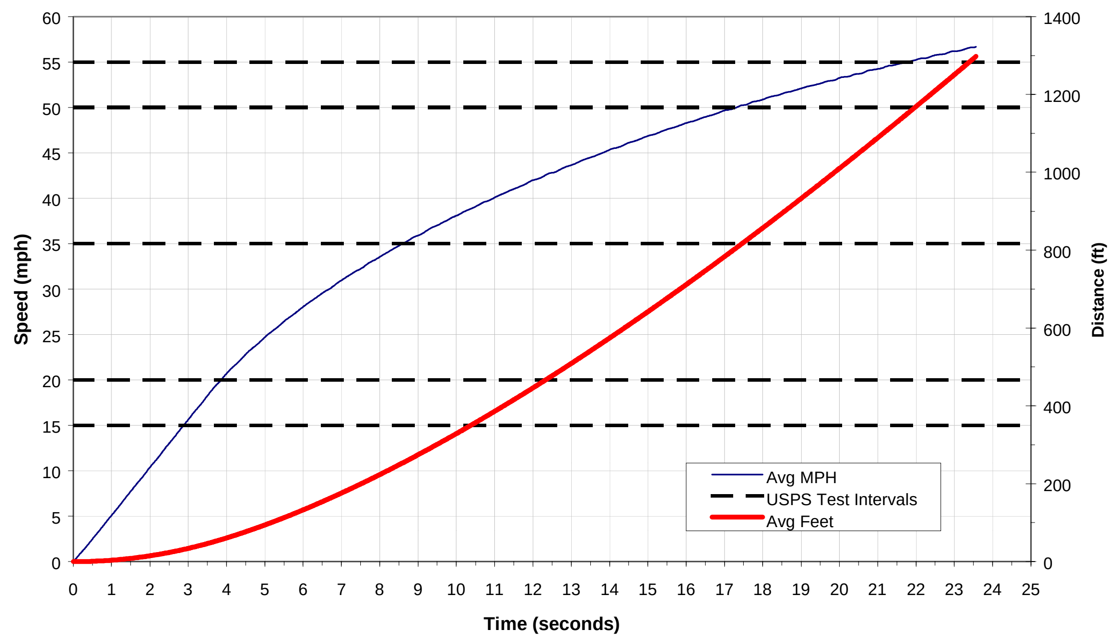


Figure 3-2 Speed and Distance Profiles for Vehicle #3

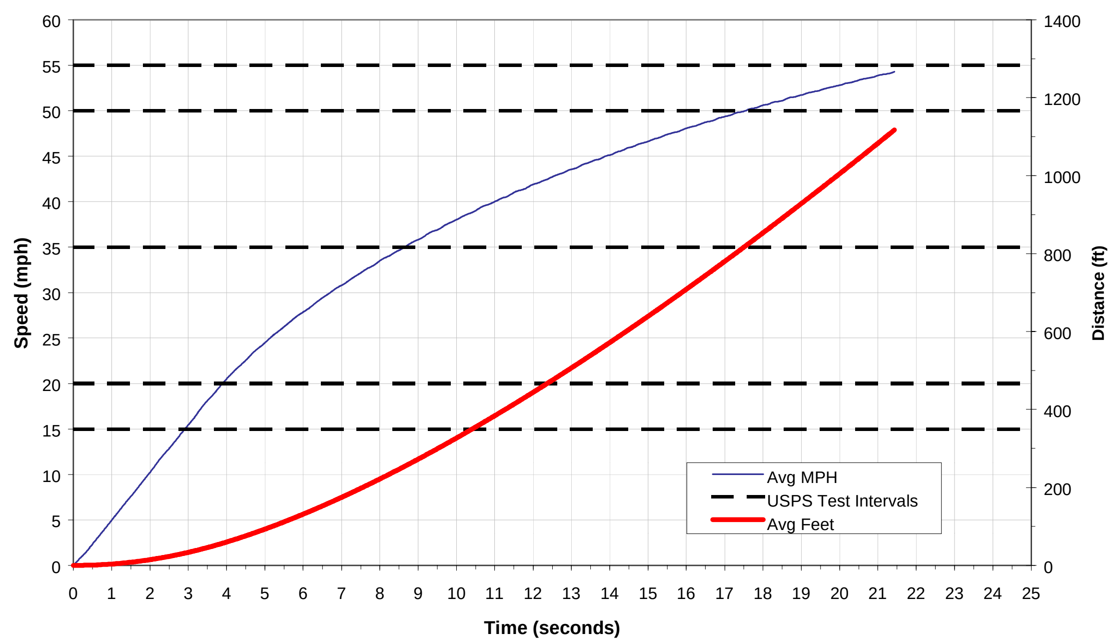


Figure 3-3 Speed and Distance Profiles for Vehicle #4

Testing of the service brake was performed in order to demonstrate the vehicle's ability to stop adequately and safely under an emergency stop. The tests were conducted from a speed of 20 mph to 0 mph and were performed in opposite directions each time. As the results in Table 3-1 show, the vehicles were able to stop within the allotted distance of 25 feet. Both vehicles did not show any signs of abnormal performance while conducting the brake tests. While braking, the vehicles stayed within a 10-foot lane, demonstrating no loss of control.

The Post Office requirements for braking states that "the minimum acceptable performance of the vehicle is the ability to adequately control and hold the vehicle in either direction (forward and reverse) on a 20% grade at the maximum GVW". Therefore while measuring parking brake performance, all equipment used for parking should be employed; i.e., the parking brake should be engaged and the transmission should be set to park. The vehicle meets the Post Office's requirement, for parking brake performance. For analysis purposes, the vehicles were tested in a more stringent scenario. Under this testing only the hand brake was engaged and the vehicle drive train was in neutral. In these conditions, the vehicle remained in place in the ascending (front of vehicle facing upgrade), but began to move at a grade higher than 14.6% in the descending direction. Again, with the transmission in park, the vehicle did meet the minimum requirements of the USPS.

Gradeability Test

Gradeability tests will be performed on a four-wheel dynamometer at a Mercedes Benz test facility on November 2nd, 2000. The testing will take approximately one week and will include gradeability at speed tests and dynamometer road load simulation tests.

Although the Dynamometer testing facility has not yet been utilized, the gradeability limit of both vehicles were determined by means of producing an actual grade on a flat bed tow truck. Both vehicles were capable of starting and ascending a 25% grade when loaded with maximum payload at 50% SOC. Two means of measurement were used for verification of results; taking measurements from a level reference and using an angle protractor with an accuracy of $\pm 1^o$ (see Figure 3-4).

Figure 3-4 Gradeability Setup and Equipment at 25% Grade

Road Handling Test

The road handling test documents the handling and maneuverability of the USPS EV at different States of Charge (SOC) over a prescribed course. The purpose of this test is to determine the minimum time required for a vehicle to safely negotiate an SCCA-style Road Handling Course similar to the one shown in the figure below. This test is not intended to determine the range or speed capabilities of any vehicle. 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. For comparison purposes, a gasoline USPS Long Life Vehicle (LLV) was tested along side the EV version.

Figure 3-5 Road Handling Course Layout

These tests were performed at minimum and maximum payload for both electric and gasoline USPS vehicles. Electric vehicle #1240003 was tested at a maximum payload of 1250 lbs and electric vehicle #1240004 was tested at a minimum payload of 170 lbs. The gasoline LLV was tested at both maximum and minimum payloads.

The road handling tests were performed on October 16th, 2000 at the Fairplex Main Lot North. As seen in the pictures on Figure 3-5, the parking lot location provided ample room for laying out the course. The average ambient temperature during testing was 82.6 ^{o}F and the wind velocity was 3 mph in the northern direction with a few gusts reaching 5 mph.

Table 3-2 below, shows the results obtained on the road handling course for all vehicles tested. The results show that the road handling times of both the EV and gasoline vehicles are very similar.

Table 3-2 Road Handling Test Results

	90% SOC	50% SOC	20% SOC
EV #3 (max payload)	74.02 s	72.50 s	69.79 s
EV #4 (min payload)	56.51 s	56.32 s	55.95 s
Gas (max payload)	69.35 s		
Gas (min payload)	56.02 s		

Results are average of two test runs.
Maximum payload 1250 lb; Minimum payload 165 lb

After completing all the testing runs, the driver completed a driveability survey. The driver felt that both electric and gasoline vehicles performed equally with regard to handling and safety. The survey shown below applies to all vehicles tested by the user during the road handling test.

DRIVEABILITY	**SA**	**A**	**NS**	**D**	**SD**	**NA**
1. The vehicle feels stable and safe	___	X	___	___	___	___
2. The vehicle steering is responsive	___	X	___	___	___	___
3. The vehicle acceleration is adequate	X	___	___	___	___	___
4. The vehicle braking is responsive and safe	X	___	___	___	___	___

SA: Strongly Agree; **A**: Agree; **NS**: Not Sure; **D**: Disagree; **SD**: Strongly Disagree; **NA**: Not Applicable

Water Test

The water test examines the vehicle's ability to endure water hazard conditions in a short time frame. The purpose of this test is to determine the amount of leakage current from battery to chassis and from chassis to ground when the vehicle is driven through a standing water area. To reproduce the effects of splashing water, a sprinkler setup with four sprinkler heads was used for wetting the underside of the vehicle. See Photo # 8 in Appendix D.

Testing of the leakage currents was done with a Simpson Electric Company, Current Leakage Tester (Model 228). "Leakage Current" is a generic term that is related to various types of unwanted currents. Leakage currents can be those that flow to ground or chassis through the human body due to inadequate insulation or improper grounding between internal supplies and accessible conductive parts.

The water tests have been completed on October 31st, 2000. The data is currently being analyzed.

Road Range Test

The maximum range was tested on the Pomona USPS delivery route (see Appendix E for map) at the vehicle's maximum legal weight limit (without exceeding the gross axle weight ratings). The Pomona USPS delivery route duplicates the stop and go driving style of a house-to-house delivery route. The average of two tests that were within 5% of each other was used as the final result.

In addition, two range tests were conducted, one UR-1 (minimum payload) and one UR-3 (maximum payload), to obtain an urban driving range for the vehicles. These tests were completed on the Pomona Loop, seen in Appendix E.

Table 3-3 Road Range Test Results

	USPS Delivery Route	UR-1	UR-3
Veh #3	29.4	48.5	42.4
Veh #4	32.7	44.7	42.6

The results in Table 3-3 above shows that the range of the vehicles will drop considerably when comparing a normal urban driving route to a stop-and-go postal delivery route. A drop in range in this situation is normal for an electric vehicle as well as a gasoline-powered vehicle due to the large amounts of energy that acceleration requires.

State of Charge Meter Evaluation

While driving the vehicles on the Pomona USPS delivery route the miles driven per division of the SOC meter were recorded. A plot of this data (shown in Figure 3-6) gives a representation of the distance covered by vehicle versus SOC indications. It should be noted that the total achievable range of the vehicle is not found at the indicated 0% SOC reading, due to reserve battery energy that is not shown. A flashing low-battery warning light, which comes on approximately five to six miles after reaching 0% SOC, is used as the stop condition. Even after reaching the flashing warning light, the vehicle can be safely operated until the Power Limit light comes on.

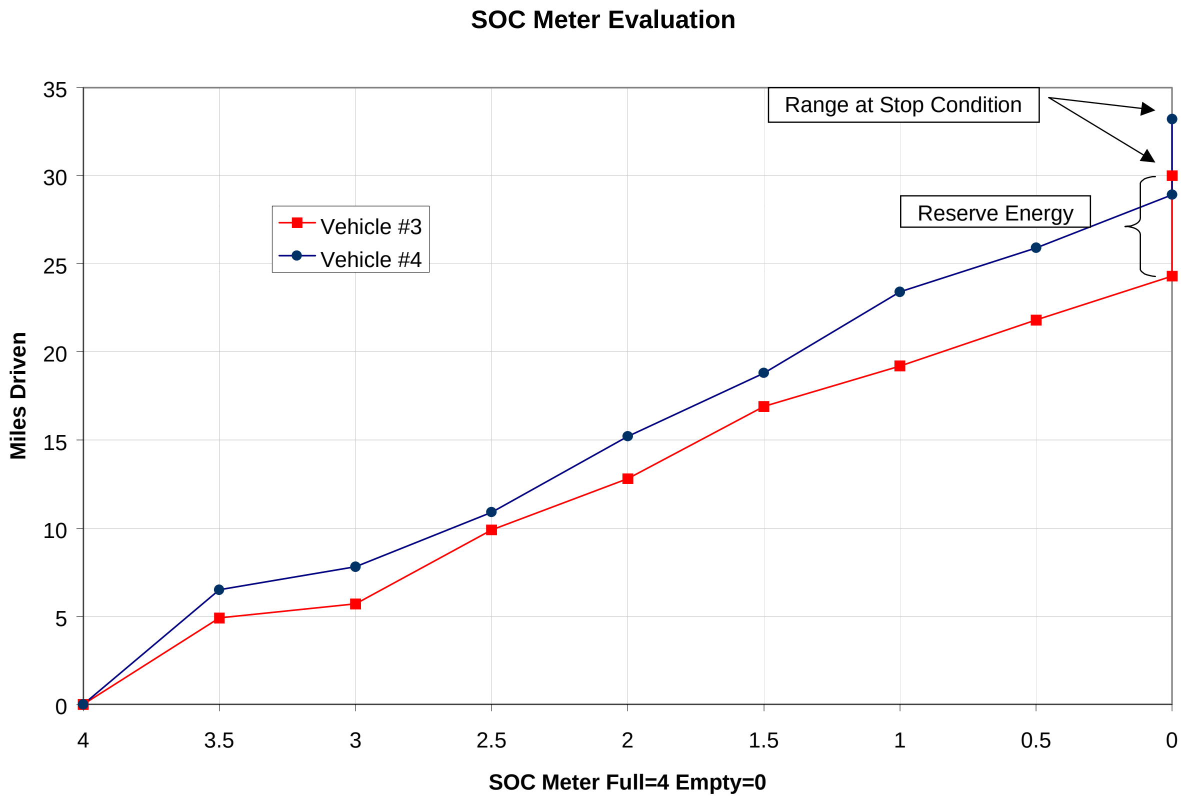


Figure 3-6 Delivery Route SOC Meter Evaluations for Vehicles #3 and #4

Note: After reaching 0% SOC, the vehicle can be driven until the battery light begins to flash (Stop Condition)

AC kWh per Mile Economy

To determine the AC kWh per mile economy, the vehicles were driven on the USPS delivery route until the stop condition was reached (stop condition is determined when the battery light begins to flash). During these drives the total number of miles driven was recorded and the total AC kWh energy consumed during recharge was also recorded. The total AC kWh used divided by the total miles driven, yielded an approximate figure for AC kWh per mile economy. The average of two drives was used to determine the final AC kWh/mile economy. As previously mentioned, the economy of a vehicle will drop during stop and go conditions regardless of fuel type.

Table 3-4 AC kWh per Mile Economy

	USPS Delivery Route		Pomona UR-3	
	Veh #3	Veh #4	Veh #3	Veh #4
Total Miles Driven	29.9	35.4	43.1	43.7
AC kWh Recharge	29.6	31.0	30.0	30.0
AC kWh/mi	0.990	0.876	0.696	0.686

Battery Charging

The USPS delivery vehicles are charged conductively by means of an on-board charger and an off-board Electric Vehicle Supply Equipment (EVSE). The EVSE verifies the proper connection between the utility grid and the electric vehicle before beginning the charging process. The EVSE is a lightweight device that can be mounted on a wall, pedestal or can be portable. The EV uses an AVCON charging connector (see figure below) that is part of the EVSE.

Figure 3-7 AVCON Charging Connector and Charge Port

The power quality characteristics of the charging systems were measured at the AC side with the use of a PowerProfiler 3030A manufactured by Dranetz-BMI. Table 3-5 shows various charger power quality characteristics recorded at minimum power input and at maximum power input. Since the bulk of the charge is returned at maximum power input, the characteristics at this phase should be examined more closely. EV chargers are designed to function optimally when charging at maximum power. The vehicles were found to have a maximum power input of 23.98 A and 24.03 A for vehicles three and four. Both USPS vehicles had a total power factor (PF) of 1.00, which clearly satisfied the IWC recommendations of greater than 0.95. The voltage total harmonic distortion (THD) was found to be 0.9% for vehicles three and four. The current THD was found to be 4.7% and 3.7% for vehicles three and four. The USPS vehicles met the requirements for maximum allowable current THD, which is recommended to be less than 20% by IWC.

Table 3-5 Charger Performance

	Vehicle #3		Vehicle #4	
Measured Value	**Minimum Power**	**Maximum Power**	**Minimum Power**	**Maximum Power**
Voltage (Phase-N)	118.3 V	117.7 V	120.0 V	120.0 V
Current	1.55 A	23.98 A	0.630 A	24.03 A
Real Power	0.357 kW	5.622 kW	0.136 kW	5.749 kW
Reactive Power	-56.79 VAR	403.9 VAR	-13.6 VAR	417.6 VAR
Apparent Power	0.365 kVA	5.644 kVA	0.152 kVA	5.768 kVA
Total Power Factor	0.98 PF	1.00 PF	0.90 PF	1.00 PF
Displacement Power Factor	0.99 dPF	1.00 dPF	1.00 dPF	1.00 dPF
Voltage THD	1.0%	0.9%	0.9%	0.9%
Current THD	14.5%	4.7%	48.1%	3.7%

	USPS Requirement	Vehicle #3	Vehicle #4
Total Charging Time	< 8 hours	7 hours, 36 minutes	6 hours, 26 minutes
Total Energy Consumption		29.04 AC kWh	29.08 AC kWh

Time observed on Stand-by	24 hours	24 hours
Total Energy Consumption	8.77 kWh	8.79 kWh

Note: Data was recorded after the USPS delivery range tests on September 11th and 13th.
Values recorded on the AC (input) side of the charger (240 V Phase-Phase).
Average ambient temperature at start of charge: 97.1°F

Charging Profile

Recording the energy delivered to the vehicle at one-minute intervals produced the charging profiles seen in Figure 3-8 below. The recharge tests were performed after a USPS delivery route range test. The profiles show that the charger resets hourly to recalibrate the charging system. The recalibration is also a characteristic seen on the Ford Ranger charging profile. The profiles below show that the bulk of the charge is delivered within 5 hours, thereafter the charging demand decreases until the charge is completed.

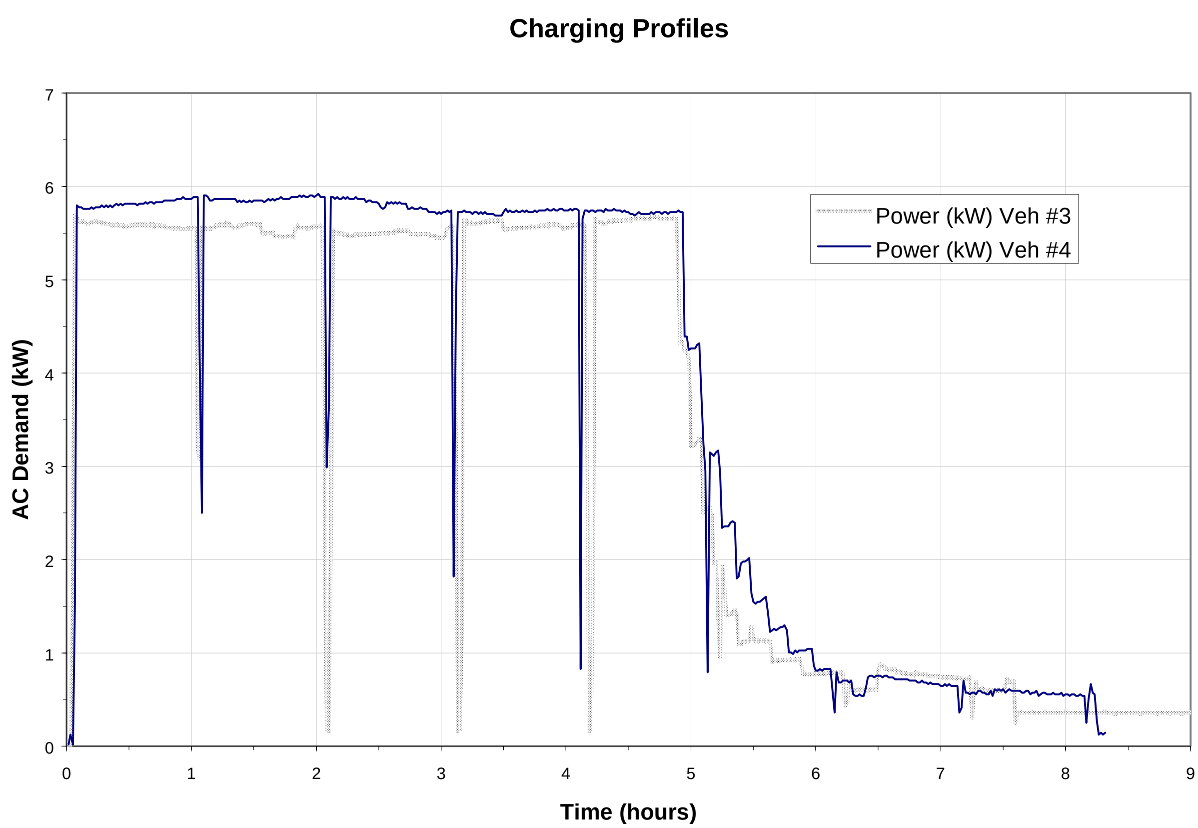


Figure 3-8 Charging Profiles for Vehicles #3 and #4

Figure 3-9 shows the calculated driving range as a function of charging time based on the results of the charging tests performed on vehicle #3 and #4 on September 11th and 13th, 2000. These results are based on using a single EVSE that is rated at 208 or 240 V and a maximum rated input and output of 40 A dedicated to a single vehicle. The EVSEs used in the field by the USPS differ from those tested at the EVTC in that two vehicles are served by a single EVSE.

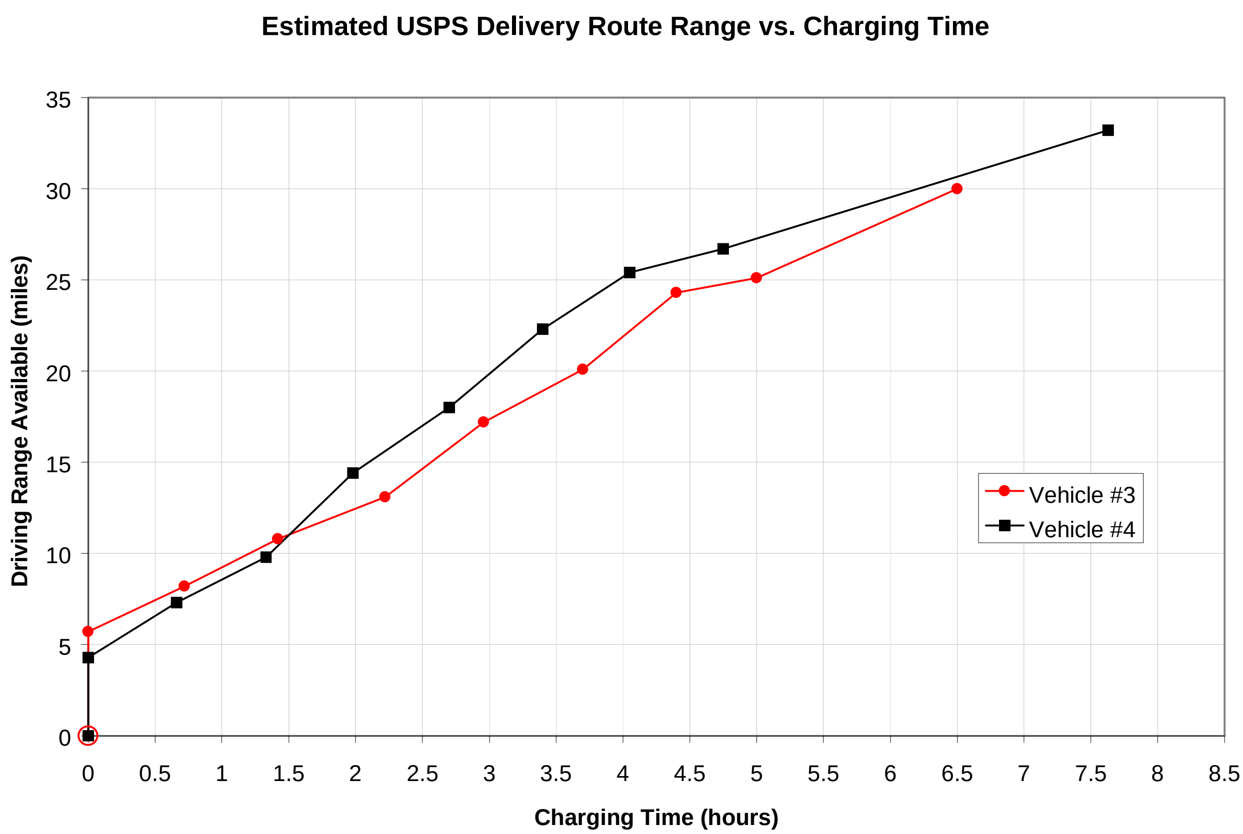


Figure 3-9 Estimated Driving Range as a Function of Charging Time

Charging System Energy Efficiency

Chargers should be designed to be as efficient as possible and must attempt to meet recommendations set by professional institutions such as the National Electric Vehicle Infrastructure Working Council (IWC). IWC recommends that level 2 chargers should have a minimum full power conversion efficiency of 85%. Full power conversion efficiency is computed by dividing the maximum power recorded on the battery side by the maximum power recorded on the AC side. Since the charger delivers the bulk of the charge at maximum power and because low charger efficiency is not critical at low power, efficiency is most important when the charger is delivering maximum power. Table 3-6 shows the charging system's efficiency for the total charging cycle as well as the charging system's efficiency at the maximum charging power. The results show that the charging system does meet the recommendations set by IWC for charging at maximum power.

Table 3-6 Power Conversion Efficiency

	AC kWh recharge	DC kWh recharge	Charging System Efficiency Over Total Charging Cycle		Maximum AC kW Power	Maximum DC kW Power	Charging System Efficiency at Maximum Power
Vehicle #3	29.18	23.80	81.6%		5.63	4.79	85.1%
Vehicle #4	29.22	23.95	82.0%		5.80	5.04	86.9%

Figure 3-10 below, shows where the measurements were recorded while analyzing the charging system's efficiency. Since current sensors cannot read the energy delivered to the parasitic loads, only a total charging system efficiency can be taken. Total system efficiency while charging is an important characteristic for determining how the system uses the energy that the charger delivers.

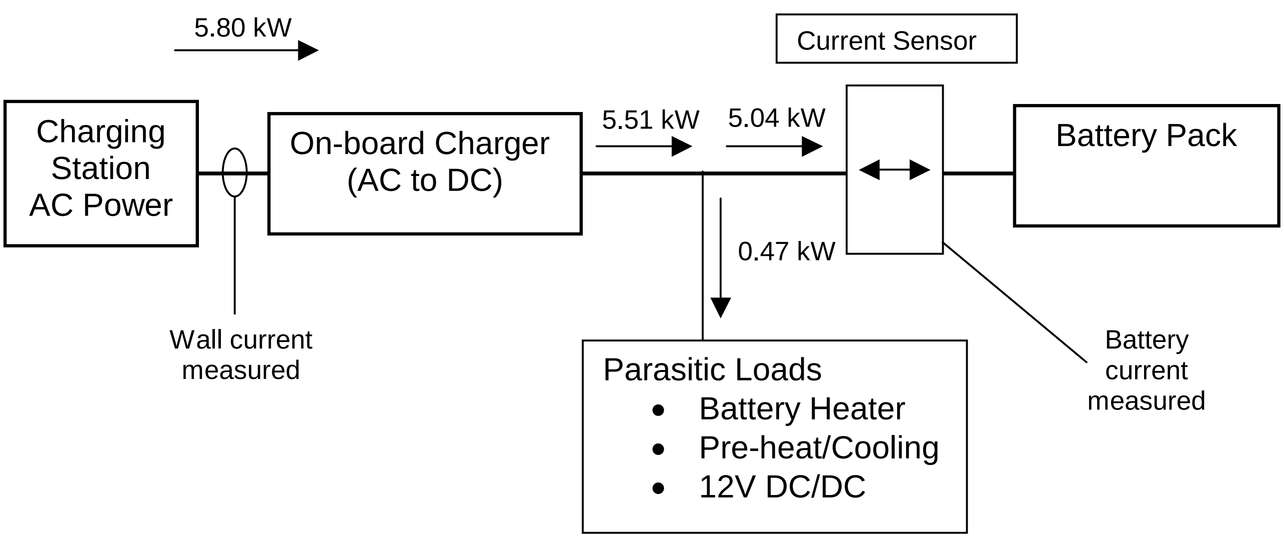


Figure 3-10 Power Distribution During Charge

Overcharge Factor

Table 3-7 shows the results of energy measurements taken for successive drives and charges for vehicles 3 and 4. The drives for each vehicle were full range discharges on the Pomona USPS delivery route. The drives for the two vehicles were consistent in range, and had an average battery discharge of about 22 kWh DC. The energy return was 23.80 kWh for vehicle 3 and 23.95 for vehicle 4. Thus the energy return was 1.097 times the energy discharge for vehicle 3, and 1.081 for vehicle 4, which is about 10% energy overcharge. Based on ampere-hour capacity, the charge return was essentially 1.0. The long-term recharging strategy will be discussed with Ford in detail and explained in future reports. In addition, the charge history of these vehicles will be examined to determine the periodic equalization strategy.

Table 3-7 Overcharge Factor

	DC kWh Out (Drive)	DC kWh In (Charge)	Overcharge Factor
Vehicle #3	21.69	23.80	1.097
Vehicle #4	22.17	23.95	1.081

Sound Level Test

Sound level tests were performed while charging and while driving on the Pomona USPS Delivery Route, to measure the sound level exhibited by the electric vehicle. Figures 3-11 and 3-12 show the sound profiles recorded when driving vehicles three and four. The average sound level found at ear-level within the vehicle's cabin was 57.1 dBA for vehicle #3 and 58.0 dBA for vehicle #4. The sound levels results cannot be compared to other EVs, since there are no previous results for the Pomona USPS Delivery Route. As a reference, other OEM vehicles average 60 dBA on the Pomona Loop. This higher sound level could be attributed to the fact that the average speed is higher on the Pomona Loop.

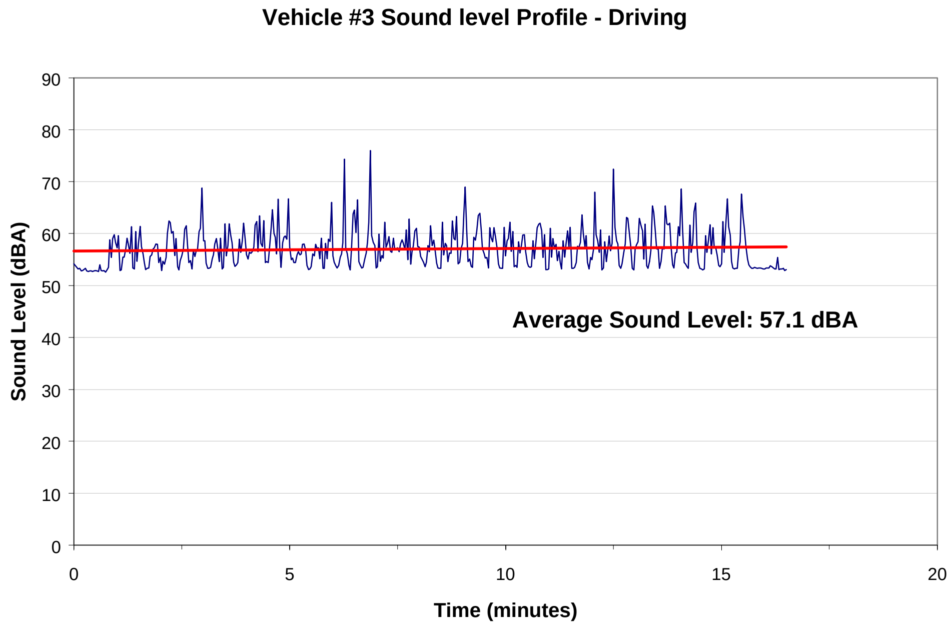


Figure 3-11 Driving Sound Level Profile – Vehicle #3

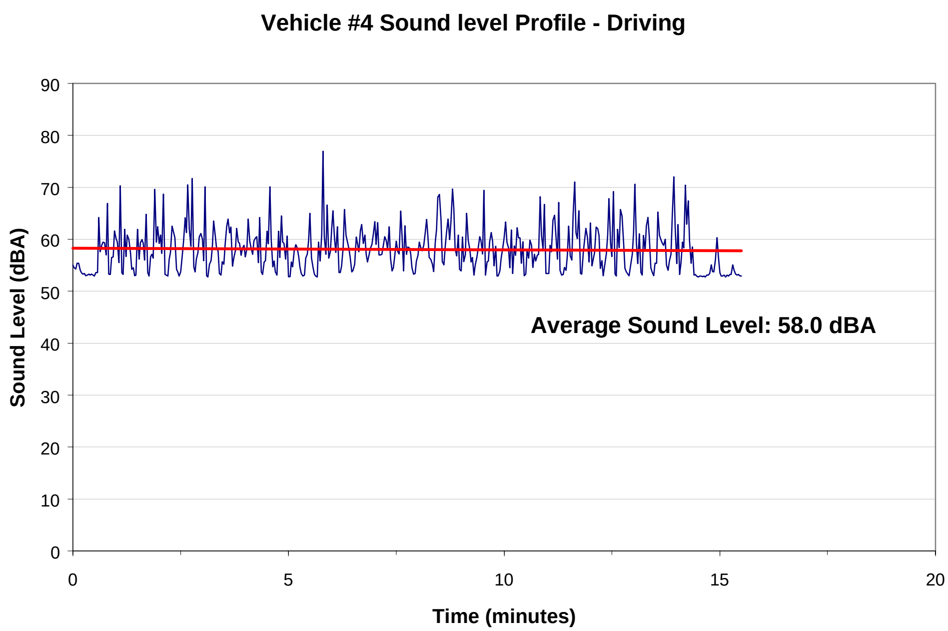


Figure 3-12 Driving Sound Level Profile – Vehicle #4

While performing the charging sound level tests, there were some variables such as passing airplanes that could not be excluded from the sound profiles. These variables are seen as spikes on the sound profile and should be neglected. Figures 3-13 and 3-14 show the sound profiles recorded while charging the vehicle. The sound levels were found to be three to four decibels lower, when comparing to the charging sound levels of other tested OEM EVs (60.2 dBA for Toyota RAV4 EV; 61.4 dBA for Nissan Altra; both using an off-board Inductive Charger).

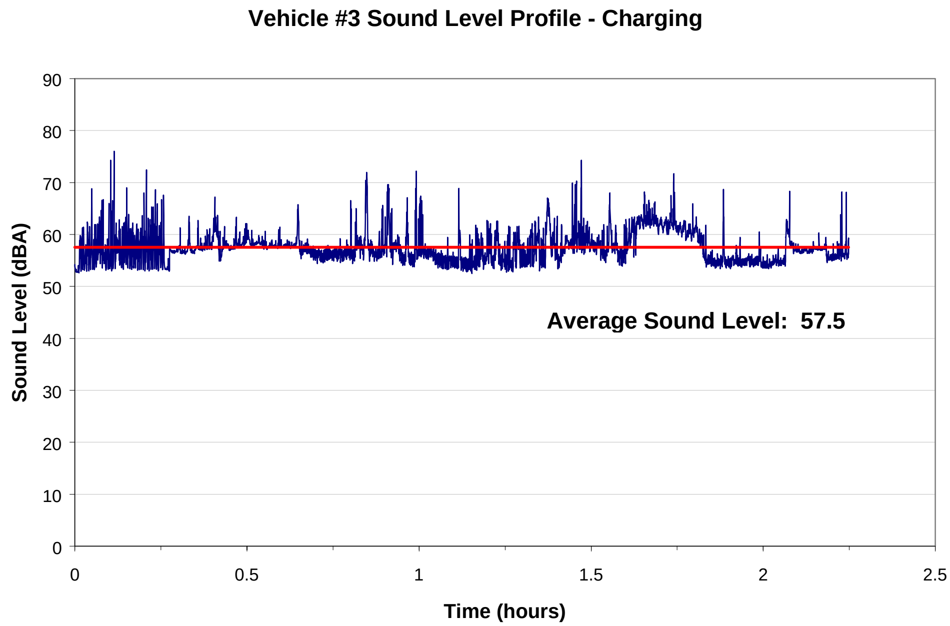


Figure 3-13 Charging Sound Level Profile – Vehicle #3

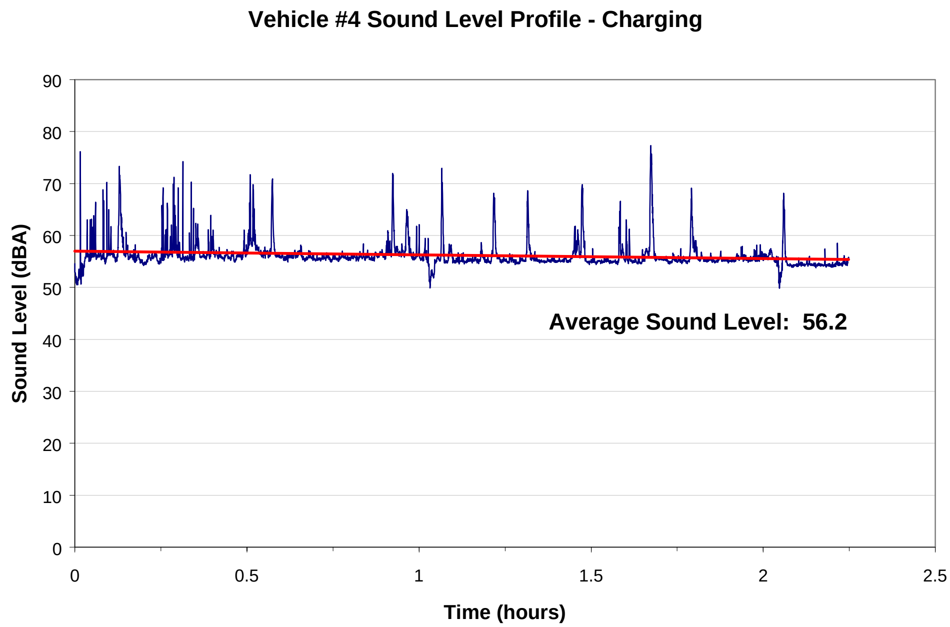


Figure 3-14 Charging Sound Level Profile – Vehicle #4

EMF Test

The electro-magnetic field in several frequency ranges, both inside and outside the electric vehicles were measured during normal driving conditions and while charging. ***EMF Education and Research***[*] of Southern California Edison performed the EMF testing required for the USPS vehicles.

Objective

The main object of the EMF testing, as a part of the EV evaluation, is to compare the differences in magnetic field levels, both inside and outside the electric vehicle (EV) and gasoline-powered vehicle (GV) during the normal driving conditions and while the EV is being charged. The following characteristics will be measured:

- AC low frequency magnetic fields (40 - 800 Hz)
- Presence of Harmonics (15 Hz to 3,000 Hz)

Testing Dates

September 26

GV magnetic field characterization while in driving
GV ID: 4315672

- Starting time: 10:00 a.m.
- Ending time: 10:40 a.m.

September 27

EV magnetic field characterization while in driving
EV ID: 1240004

- Starting time: 10:35 a.m.
- Ending time: 11:05 a.m.

September 28

EV magnetic field characterization while being charged
EV ID: 1240004

- Starting time: 11:00 a.m.
- Ending time: 5:20 p.m.

Testing Locations

EVTC located in Pomona and USPS Testing Course; See Appendix E for more information.

Principle investigators: Charles J. Kim and Brian Thorson

Testing Instruments

- EMDEX II
  Frequency range: 40 ~ 800 Hz
- EMDEX C
  Frequency range: 40 ~ 400 Hz
- MultiWave II
  Frequency range: 0 ~ 3,000 Hz

Note: All meters were checked for calibration on June 2000.

Testing Procedure

The magnetic fields are measured while driving the EV and GV along the designated route; referred to the Appendix E for more information. There are three different states of driving

- "Stop and go" simulating mail delivery. It takes approximately 15 minutes to complete the route. Only distribution lines are present along the route.
- Driving 20 to 30 mph in a residential area while obeying all traffic signs and signals. It takes approximately 5 minutes to complete the route.
- Driving 30 to 40 mph along the major street while obeying all traffic signs and signals. It takes approximately 15 minutes to complete the route.

The sampling rates for the above testing are as follows:

- Sampling Rate for EMDEX II: 5 second intervals
- Sampling Rate for the MultiWave II: 10 second intervals

In addition to the driving test, the magnetic fields were measured while the EV was in charging mode.

- Sampling Rate for EMDEX II and EMDEX C: 5 seconds intervals
- Sampling Rate for the MultiWave II: 60 seconds intervals

Instrument Locations

Figure 3-15 shows the locations of EMDEX II, EMDEX C, and MultiWave II meters. The locations of other meters can be seen in pictures 1 through 6 of Appendix D, page 46.

Location 1 indicates the center of the front seat; see Photo 2. The MultiWave II was placed one meter above the base and an EMDEX II meter was placed directly beneath (one foot below) of MultiWave II probe; see the Photo 2 for the detail.

At the location 2, one EMDEX II was placed on front of driver's chest and the other one was placed on the driver's right side of the waist; see the Photo 1. The location "C" indicates the places for the EMDEX C meters. EMDEX C meters were only used during the charging stage. Four EMDEX C meters were placed approximately one foot from the vehicle. Two EMDEX C meters were placed approximately two feet away from the front doors, right next to other EMDEX C meters.

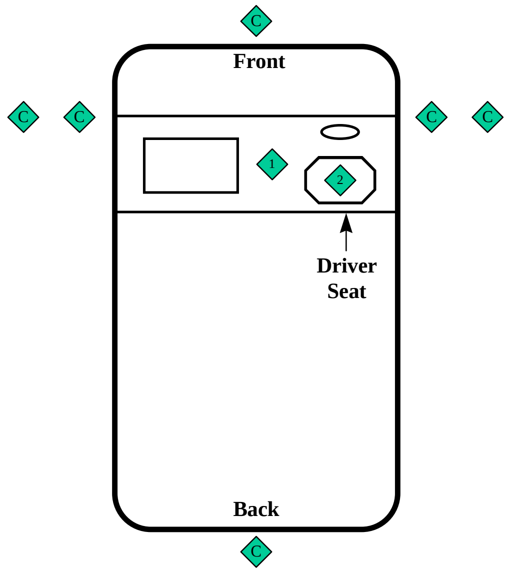


Figure 3-15 Meter Locations

Analysis

Driving Mode

Figure 3-16, clearly illustrates that there are no significant differences in magnetic fields while driving either an EV or a GV. It was observed that the magnetic fields increased slightly while accelerating. When the vehicles were at relatively constant speed, there were no significant variations of the magnetic fields; changes were smaller than approximately 0.3 mG.

The following observations were made when the vehicles were in motion:

- The average % THD (Total Harmonic Distortion) level for the EV was approximately 62% whereas for the GV was 42%.
- According to the Multiwave II data, the dominant frequencies for the EV were 60 Hz and 180 Hz and for the GV, they were about 10 Hz and 495 Hz. This indicates that EMDEX IIs were able to capture the dominant frequencies.
- The average of magnetic fields for EV on the driver's side was approximately 0.33 (standard deviation = 0.25) mG and for the GV was 0.30 (standard deviation = 0.25) mG. Considering that two cars are not identical in size (for example the EV has bigger wheels than GV) and variations of driving conditions, we could conclude that the magnetic field level differences are not statistically significant[1].

[1] The average values and standard deviations are derived from Figure 3-16. Figure 3-16 was drawn by randomly selecting data from the population in order to match the samples sizes for both EV and GV.

- Please refer to the Appendix B for the magnetic fields variations at different meter locations.

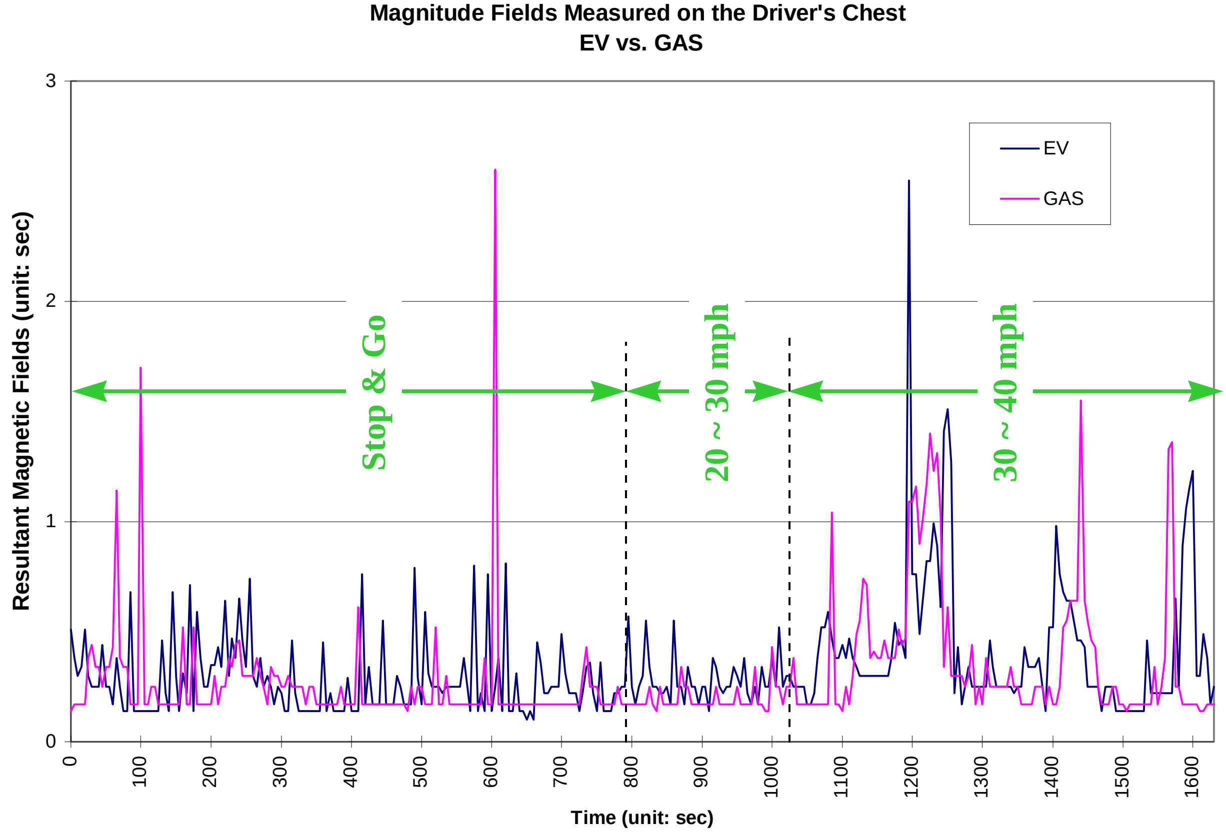


Figure 3-16 Magnetic Fields in an EV and GV

EV in Charging Mode

Appendix C shows the magnetic field levels for both inside and outside of electric vehicles. The ambient magnetic fields were similar to five percentile magnetic fields levels around the EV.

While the EV was in the charging mode, the magnetic fields were elevated approximately 1.0 mG at one foot away from the EV compared to the ambient magnetic level. The power cable that connects the charger to the vehicle was located right side of the vehicle. This explains the elevated magnetic fields on the right side of the EV.

Typical charging duration is about eight hours. The magnetic field levels remain relative constant for the first four hours and increased slightly for the next two hours and twenty minutes. The magnetic variances in overall were relatively small.

The %THD was relatively constant; the average was 36.8% and the standard deviation was 2.0%.

Note: The EV was completely discharged prior to the testing. Testing lasted for six hours and thirty minutes.

EMF Conclusion

Considering the magnetic fields, there were no significant differences while driving either an EV or a GV. It was observed that the magnetic fields increased slightly while accelerating for both vehicles. When the vehicles were at relatively constant speed, there were no significant variations of the magnetic fields; less than 0.3 mG changes.

The average of magnetic fields for EV on the driver's side was approximately 0.33 (standard deviation = 0.25) mG and for the GV was 0.30 (standard deviation = 0.25) mG. Considering that two cars are not identical in size (for example the EV has bigger wheels than GV), it can be concluded that the differences in magnetic fields level were not significant.

The EV had approximately 40% more harmonics when compared to the GV.

While the EV was in the charging mode, the magnetic fields were approximately 1.0 mG at one foot away from the EV compared to the ambient magnetic level. 1.0 mG is equivalent to sitting in front of a PC monitor. The magnetic fields in a typical house[2] in the U.S. are approximately 0.6 mG, according to an Electric Power Research Institute (EPRI) study.

Compatibility with Electronic Devices

The vehicles were tested with various devices that induce radio frequency interference and various devices that can invoke electromagnetic susceptibility. These tests were conducted in order to make sure that the electric vehicle will operate normally in the presence of these devices and also to verify the correct operation of the devices in the EV.

The table below shows the devices that were tested with the electric vehicles and whether there was any interference present within the EV or the device. The table shows that there are no anomalies present when these devices were operated within the vehicle. These tests were performed when the vehicle was turned on and while the vehicle was being driven.

Table 3-8 Interference by Electronic Devices or EV

	Vehicle #3	Vehicle #4
Cellular phone	None	None
Mobile radio	None	None
Notebook computer	None	None

[2] Typical house means 50% of 1992 homes that EPRI surveyed.

Accelerated Reliability

High Mileage Driving

Vehicles one and two were chosen to take part in the high mileage driving regimens of the accelerated reliability tests. It is possible to operate each vehicle twice in one eight-hour workday to complete a total of approximately 75 to 85 miles per day. Initially the vehicles could complete two Pomona Loops (20 miles each loop) on a single charge. Recently, Vehicle #2 has not been able to complete two loops while loaded at maximum payload. The range of the vehicles will be looked at very closely over the next few weeks to determine if there are any trends present in terms of climate or cycling conditions.

With a dedicated EVSE, the total charge time can be as low as 6 hours and 30 minutes. Table 3-9 shows the mileage that has been covered up to October 18, 2000 and the energy returned to the vehicle during the charging process. The vehicle's AC kWh/mi energy economy can be computed by dividing the total energy recorded by the total miles recorded. Under the accelerated mileage drives the vehicles are driven at maximum payload on the Pomona Loop seen in Appendix E.

Table 3-9 Mileage and Energy Usage

	Reliability Vehicles	
	Vehicle #1	**Vehicle #2**
Start Odometer	153	143
Current Odometer	1644	1786
Total Miles Driven	1491	1643
Total ACkWh Used	1027.1	1188.0
AC kWh/mi	0.689	0.723

Vehicle Range

The accelerated reliability vehicles were range tested on the Pomona Loop with minimum payload and maximum payload at the start of testing in order to compare the range difference. Table 3-10 shows the initial minimum payload range of vehicles one and two and Table 3-11 shows the initial and most recent maximum payload range tests for vehicles one and two.

Table 3-10 Pomona Loop Range Test with Minimum Payload

	Vehicle #1	Vehicle #2
Date Tested	8-29-00	8-31-00
Pomona UR-1 Range at Stop Condition	42.6	44.9
Total Miles Driven on UR-1	43.5	46

Table 3-11 Pomona Loop Range Test with Maximum Payload

	Vehicle #1		Vehicle #2	
Date Tested	8-30-00	10-12-00	9-01-00	10-12-00
Pomona UR-3 Range at Stop Condition	43.3	41.9	43.4	37.9
Total Miles Driven on UR-3	45.3	46.0	43.9	39.0

Under these range tests, the vehicles were driven until they reached the stop condition, which is when the battery light begins to flash. The vehicles can be safely driven further past the stop condition for a few more miles until the Power Limit Light comes on solid. When the Power Limit Light begins to flash the vehicle's top speed will be 25 mph (to protect the battery pack).

On-Board Data Acquisition System

Data has been successfully downloaded from the on-board system on a weekly basis. The on-board system is capable of recording a wide variety of information while driving and while charging. The following table shows the data recorded from September 11, 2000 until October 18, 2000 for vehicles one and two. Ford is working with SCE to adjust the accuracy of the on-board data acquisition system with the implementation of a new software version.

Table 3-12 On-board Data Acquisition System Results

		Vehicle #1	Vehicle #2
Miles Recorded		1388.1	1484.9
Driving	Pack DC Ahrs	1799.0	1953.9
	Pack DC kWhrs	586.0	635.3
Charging	Pack DC Ahrs	1602.9	2112.0
	Pack DC kWhrs	611.0	807.0
AC kWh (Estimate)		806.2	920.2
AC kWh/mi (Estimate)		0.581	0.620

Vehicle Incidents

Four vehicles were received by the EVTC testing facility on July 5th, 2000. Testing of the vehicles began on September 5th, 2000, when the EVTC received approval from USPS to begin testing. Before this date, the vehicles were only operated within the EVTC testing facility. The Table below shows the incidents that have been recorded for vehicles one and two. A charger malfunction was recorded on September 11th, 2000, which was due to a cooling fan that failed within the charger. The abnormal charging that was noticed on September 9th, 2000 may have led up to the charger failing. Another incident occurred on September 11th on vehicle two, which had to do with the power steering operating harder than normal. The power steering was replaced immediately. The power steering was again replaced on vehicle two, as an upgrade at Ford's request, on October 13th, 2000. No further problems have been noticed with either the charging systems or power steering units as of October 31, 2000.

Table 3-13 Vehicle Incidents

Vehicle	Date	Description
1240002	9-7-00	Vehicles need loading straps for payload, payload shifted abruptly without loading straps on vehicle 1240002. Loading straps obtained on 9-8-00.
1240001	9-8-00	Vehicle charger noticed to be charging abnormally, approximately 10 hours to charge. Charging profile showed that charger repeatedly charged for three minutes then turned off for seven minutes until the charge was complete. Ford is aware of the situation.
1240001	9-11-00	Charger not functioning. Repaired 9-13-00. New charger installed. Charger cooling fan failed.
1240002	9-11-00	When vehicle was driven to power limit mode the power steering on the vehicle became hard. High voltage fuse may be the problem. Repaired 9-12-00. High voltage fuse and power steering replaced.
1240002	10-13-00	Power steering upgraded. Requested by Ford.

Conclusion

Baseline testing of two USPS vehicles has proven to be valuable in comparing the performance of these vehicles against the specifications set by the Post Office and those set by other professional groups. Dynamometer testing is yet to be completed, which will include such tests as driving range on the Urban Dynamometer Driving Schedule (UDDS) and gradeability of the vehicle at speeds of 55 mph, 45 mph, and 10 mph. In addition, a high-speed gradeability test on a 2.5% grade as well as the maximum gradeability achievable will be determined.

The results obtained to date for baseline testing have shown that the USPS delivery vehicles meet all the requirements set by the U.S. Postal Service.

Acceleration testing has shown that the average time of 2.90 seconds for accelerating from 0-15 mph was well below the 5.00 seconds required by the USPS. The average time of 17.40 seconds for accelerating from 0-50 mph was also found to be well below the 22.00 seconds required by the USPS. The average braking distance for both vehicles was 23.0 feet, which met the USPS requirements of 25 feet.

Maximum gradeability was tested to determine the vehicle's ability to start and ascend a 25% grade when loaded with maximum payload at 50% SOC. Both vehicles met the requirements set for maximum gradeability.

Road handling tests have shown that there is no significant difference between the gasoline powered delivery vehicle and the electric powered delivery vehicle, at maximum or minimum payload, in terms of handling.

The road range tests have shown that the USPS vehicles have a stop-and-go delivery route range of approximately 31 miles and an urban driving range of approximately 43 miles, while operating at maximum payload.

The battery charging tests have shown that the charging system meets all USPS and IWC recommendations for maximum charging time, charger system efficiency, power factors and harmonic distortions for voltage and current.

Sound level tests performed while driving cannot be directly compared with results of other vehicles, since these are the first sound level tests performed on the Pomona USPS Delivery Route. Although a direct comparison cannot be made, the sound intensity was found to be lower than that of other OEM vehicles on the Pomona Urban Loop (different driving speeds). The charging sound levels were found to be three to four decibels lower, when comparing to the charging sound levels of other tested OEM EVs (Inductive chargers).

Considering the magnetic fields, there were no significant differences in magnetic fields while driving either an EV or a GV. While the EV was in the charging mode, the magnetic fields were approximately 1.0 mG at one foot away from the EV compared to the ambient magnetic level. 1.0 mG is equivalent to sitting in front of a PC monitor.

No incompatibilities were found between various devices and the vehicle while driving. The tested devices were a cellular phone, a mobile radio, and a notebook computer.

The accelerated reliability vehicles have been in the high mileage regimen for almost two months. In this time frame, each vehicle has seen on average between 75 to 85 miles per day. One faulty charger has been repaired on vehicle one, which was due to a faulty cooling fan. A power steering unit was also replaced on vehicle two, and was upgraded by Ford (at their discretion) a few weeks after with an improved version. No further problems have been noticed with either the charging systems or power steering units as of October 31, 2000.

APPENDIX A: PERFORMANCE TEST FORMS

USPS ACCELERATION, MAXIMUM SPEED, AND BRAKING TESTS

			Start	Stop
Vehicle No.:	1240003			
Location:	LA River Bed	**Time**	9:15 AM	3:45 PM
Date:	09/22/2000	**Temp.**	68.8	72
Technician:	Solares	**Odometer**	518	538

Acceleration (100% SOC)

	0-30 mph	0-60 mph	Direction	Max. Speed	15-35 mph	25-55 mph
1	6.74	NA	S	58	6.12	18.4
2	6.66	NA	N	65	5.95	15.99
3	6.78	34.52	S			
4	6.6	28.55	N			
Average	6.70	31.54		61.50	6.04	17.20

Acceleration (80% SOC)

	0-30 mph	0-60 mph	Direction	15-35 mph	25-55 mph
1	6.83	35.03	S	6.06	16.15
2	6.72	29.4	N	5.84	18.18
3	6.74	32.4	S		
4					
Average	6.76	32.28		5.95	17.17

Acceleration (60% SOC)

	0-30 mph	0-60 mph	Direction	15-35 mph	25-55 mph
1	6.63	33.03	S	7.46	18.21
2	6.52	29.15	N	5.87	18.75
3					
4					
Average	6.58	31.09		6.67	18.48

Acceleration (40% SOC)

	0-30 mph	0-60 mph	Direction	15-35 mph	25-55 mph
1	6.78	38.53	S	6.03	20.75
2	6.78	29.15	N	6.93	16.68
3					
4					
Average	6.78	33.84		6.48	18.72

Braking 20-0 mph, 50% SOC

	Test Distance	Corrected Distance	Direction
1	31	35.1	S
2	32	35.0	S
3	22	29.4	S
4	25	26.7	N
5	21	25.0	S
6	21	24.8	N
7	20	23.6	S
8	21	23.8	N
9			
#			

Average: 24.3 (last 4 runs)
23.7 (last 2 runs)

Acceleration (20% SOC)

	0-30 mph	0-60 mph	Direction	Max. Speed	15-35 mph	25-55 mph
1	6.54	29.5	N	63	NA	NA
2	6.86	41.65	S	61	NA	NA
3						
4						
Average	6.70	35.58		62.00	NA	NA

Comments: First four brake runs were easy, non-panic brake runs.
20% SOC tests at 15-35 and 25-55 were not performed due to low battery SOC.

USPS ACCELERATION, MAXIMUM SPEED, AND BRAKING TESTS

			Start	Stop
Vehicle No.:	1240004			
Location:	LA River Bed	**Time**	10:40 AM	3:45 PM
Date:	09/22/2000	**Temp.**	70.1	72
Technician:	Sanchez Fabian	**Odometer**	418	438

Acceleration (100% SOC)

	0-30 mph	0-60 mph	Direction	Max. Speed	15-35 mph	25-55 mph
1	6.5	NA	S	65	5.82	16.30
2	7.83	32.28	N	65	6.03	15.65
3	6.88	31.52	S			
4	6.55	31.63	N			
Average	6.94	31.81		65.00	5.93	15.98

Acceleration (80% SOC)

	0-30 mph	0-60 mph	Direction	15-35 mph	25-55 mph
1	NA	NA	NA	NA	NA
2					
3					
4					
Average	NA	NA	NA	NA	NA

Acceleration (60% SOC)

	0-30 mph	0-60 mph	Direction	15-35 mph	25-55 mph
1	6.38	33.89	S	6.33	17.44
2	6.50	26.93	N	5.94	15.02
3					
4					
Average	6.44	30.41		6.14	16.23

Acceleration (40% SOC)

	0-30 mph	0-60 mph	Direction	15-35 mph	25-55 mph
1	6.65	37.56	S	6.05	19.07
2	6.45	28.67	N	5.55	15.56
3					
4					
Average					

Braking 20-0 mph, 50% SOC

	Test Distance	Corrected Distance	Direction
1	26	30.5	S
2	24	24.1	S
3	21	23.5	S
4	21	24.3	N
5	19	22.7	S
6	18	21.5	N
7			
8			
9			
#			

Average: 23.0 (last 4 runs)
22.1 (last 2 runs)

Acceleration (20% SOC)

	0-30 mph	0-60 mph	Direction	Max. Speed	15-35 mph	25-55 mph
1	6.66	40.76	S	61	6.03	18.35
2	6.6	30.38	N	65	5.69	15.75
3	6.89					
4	7.3					
Average	6.86	35.57		63.00	5.86	17.05

Comments: Tests at 80% SOC were not completed due to SOC droping below 70% SOC
Note: at 1:36 temp 72.2 F

POMONA DRIVING TEST DATA

Date	Vehicle	VIN last 6	Test	Driver	Data File/Project		Volts
08/29/2000	Veh 1	NA	UR1	Sanchez	USPS Project	Start	NA
Road Cond	Tire Press	Payload				Stop	
Wet/Dry	35	245 lb				Net	

DRIVING	Time	Odom	% SOC	DC Ah	DC kWh	Amb temp	A/C temp	A/C>10 min
Start	14:12	171	100	NA	NA	71.8 F	NA	
Stop	15:52	215	0			71.6 F		Min. A/C
Net		44						

Distance	State of Charge		Notes / Deviations / Traffic / Weather / Performance
Miles	Veh meter	Range meter	
0	4.0		
7.5	3.5		
9.8	3.0		
12.5	2.5		
15	2.0		
23.1	1.5		
28.7	1.0		
30.8	0.5		
33	0.0		
			Total Miles 43.5
			Low charge light on at 38.5
			Low charge light flashing at 42.6

Accessories used:
Drive / Regen setting: E mode
Handling/Braking: handling normal / braking a bit rough
Other comments:

Charger	Serial No.	AC meter#	BMI #
EVC-007	F0198085	01 139 878	NA

CHARGING	Date	Time	AC kWh in	BMI kWh in	DC kWh in	DC Ah in	Amb temp	Volts
Start	08/29/2000	15:59		NA	NA	NA	NA	NA
Stop	09/13/2000	9:00						
Net			28.9					

Comments:

POMONA DRIVING TEST DATA

Date	Vehicle	VIN last 6	Test	Driver	Data File/Project		Volts
08/30/2000	Veh 1	NA	UR3	Sanchez	USPS Project	**Start**	NA
Road Cond	**Tire Press**	**Payload**				**Stop**	
Dry	35	1245				**Net**	

DRIVING	Time	Odom	% SOC	DC Ah	DC kWh	Amb temp	A/C temp	A/C>10 min
Start	9:42	215	100	NA	NA	70.0 F	NA	
Stop	11:30	261	0			77.9 F		**Min. A/C**
Net		46						

Distance	State of Charge		Notes / Deviations / Traffic / Weather / Performance
Miles	**Veh meter**	**Range meter**	
0	4.0		
5	3.5		
6.4	3.0		
10	2.5		
12.6	2.0		
23.1	1.5		
28.8	1.0		
30.7	0.5		
32.9	0.0		
			Total Miles 45.3
			Low charge light on at 35.5
			Low charge light flashing at 43.3

Accessories used:
Drive / Regen setting: E mode
Handling/Braking: handling normal / braking a bit rough
Other comments:

Charger	Serial No.		AC meter#		BMI #			
EVC-007	P04		01 139 878		NA			
CHARGING	**Date**	**Time**	**AC kWh in**	**BMI kWh in**	**DC kWh in**	**DC Ah in**	**Amb temp**	**Volts**
Start	08/30/2000	13:08		NA	NA	NA	76.6 F	NA
Stop	08/31/2000	9:00						
Net								

Comments:

POMONA DRIVING TEST DATA

Date	Vehicle	VIN last 6	Test	Driver	Data File/Project		Volts
08/31/2000	Veh 2	NA	UR1	Sanchez	USPS Project	**Start**	NA
Road Cond	**Tire Press**	**Payload**				**Stop**	
Dry	35	245 lb				**Net**	

DRIVING	Time	Odom	% SOC	DC Ah	DC kWh	Amb temp	A/C temp	A/C>10 min
Start	12:00	164	100	NA	NA	77.4	NA	
Stop	15:04	210	0			79.7		**Min. A/C**
Net		46						

Distance	State of Charge		Notes / Deviations / Traffic / Weather / Performance
Miles	**Veh meter**	**Range meter**	
0	4.0		
6.7	3.5		
10.1	3.0		
12.4	2.5		
15.2	2.0		
23.4	1.5		
29.8	1.0		
32.4	0.5		
36.1	0.0		
			Total Miles 46
			Low charge light on at 42.4
			Low charge light flashing at 44.9

Accessories used:
Drive / Regen setting: E mode
Handling/Braking: handling normal / braking a bit rough
Other comments:

Charger	Serial No.		AC meter#		BMI #			
P031			01 712 275		NA			
CHARGING	**Date**	**Time**	**AC kWh in**	**BMI kWh in**	**DC kWh in**	**DC Ah in**	**Amb temp**	**Volts**
Start	08/31/2000	15:05		NA	NA	NA	NA	NA
Stop	09/01/2000	9:00						
Net								

Comments:

POMONA DRIVING TEST DATA

Date	Vehicle	VIN last 6	Test	Driver	Data File/Project		Volts
09/01/2000	Veh 2	NA	UR3	Sanchez	USPS Project	Start	NA
Road Cond	Tire Press	Payload				Stop	
Dry	35	1245				Net	

DRIVING	Time	Odom	% SOC	DC Ah	DC kWh	Amb temp	A/C temp	A/C>10 min
Start	9:05	210	100	NA	NA	68.1 F	NA	
Stop	10:40	254	0			70.7 F		Min. A/C
Net		44						

Distance	State of Charge		Notes / Deviations / Traffic / Weather / Performance
Miles	Veh meter	Range meter	
0	4.0		
6.7	3.5		
9.2	3.0		
11.8	2.5		
19.4	2.0		
25.5	1.5		
29.6	1.0		
30.7	0.5		
34.8	0.0		
			Total Miles 43.9
			Low charge light on at 39.9
			Low charge light flashing at 43.4

Accessories used:

Drive / Regen setting: E mode

Handling/Braking: handling normal / braking a bit rough

Other comments:

Charger	Serial No.	AC meter#	BMI #
EVC-031	P031	01 712 275	NA

CHARGING	Date	Time	AC kWh in	BMI kWh in	DC kWh in	DC Ah in	Amb temp	Volts
Start	09/01/2000	10:42		NA	NA	NA	NA	NA
Stop	09/02/2000	9:00						
Net								

Comments:

POMONA DRIVING TEST DATA

Date	Vehicle	VIN last 6	Test	Driver	Data File/Project		Volts
09/12/2000	Veh 3	NA	USPS	Sanchez	USPS Project	**Start**	NA
Road Cond	**Tire Press**	**Payload**				**Stop**	
Dry	35	1245 lb				**Net**	

DRIVING	Time	Odom	% SOC	DC Ah	DC kWh	Amb temp	A/C temp	A/C>10 min
Start	9:10	457	100	NA	NA	80.9 F	NA	
Stop	12:14	486	0			100.4 F		**Min. A/C**
Net		29						

Distance	State of Charge		Notes / Deviations / Traffic / Weather / Performance
Miles	**Veh meter**	**Range meter**	
0	4.0		
5	3.5		
5.6	3.0		
8.8	2.5		
11.4	2.0		
140	1.5		
18.1	1.0		
20.3	0.5		
22.7	0.0		
			Total Miles 29.4
			Low charge light on at 24.3
			Low charge light flashing at 28.8
			Power limit

Accessories used: Fan / Low

Drive / Regen setting: E mode

Handling/Braking: handling normal / braking a bit rough

Other comments:

Charger	Serial No.		AC meter#		BMI #			
#4	PO53		620		NA			
CHARGING	**Date**	**Time**	**AC kWh in**	**BMI kWh in**	**DC kWh in**	**DC Ah in**	**Amb temp**	**Volts**
Start	09/12/2000	2:00			NA	NA		NA
Stop	09/13/2000	9:00						
Net			32.52	32.73				

Comments: 6.48 hour charge

POMONA DRIVING TEST DATA

Date	Vehicle	VIN last 6	Test	Driver	Data File/Project		Volts
09/13/2000	Veh 3	NA	USPS	Sanchez	USPS Project	**Start**	NA
Road Cond	**Tire Press**	**Payload**				**Stop**	
Dry	35	1245 lb				**Net**	

DRIVING	Time	Odom	% SOC	DC Ah	DC kWh	Amb temp	A/C temp	A/C>10 min
Start	9:00	486	100	NA	NA	81.3 F	NA	
Stop	12:07	516	0			93.7 F		**Min. A/C**
Net		30						

Distance	State of Charge		Notes / Deviations / Traffic / Weather / Performance
Miles	**Veh meter**	**Range meter**	
0	4.0		
4.9	3.5		
5.7	3.0		
9.9	2.5		
12.8	2.0		
16.9	1.5		
19.2	1.0		
21.8	0.5		
24.3	0.0		
			Total Miles 30.4
			Low charge light on at 26.0
			Low charge light flashing at 30.0

Accessories used: Fan / Low

Drive / Regen setting: E mode

Handling/Braking: handling normal / braking normal

Other comments:

Charger	Serial No.		AC meter#		BMI #			
#4	PO53		620		NA			
CHARGING	**Date**	**Time**	**AC kWh in**	**BMI kWh in**	**DC kWh in**	**DC Ah in**	**Amb temp**	**Volts**
Start	09/13/2000	2:00			NA	NA		NA
Stop	09/14/2000	9:00						
Net			29.92	29.49				

Comments: 7.58 hour charge time

POMONA DRIVING TEST DATA

Date	Vehicle	VIN last 6	Test	Driver	Data File/Project		Volts
09/05/2000	Veh 3	NA	UR1	Sanchez	USPS Project	**Start**	NA
Road Cond	**Tire Press**	**Payload**				**Stop**	
Dry	35	245 lb				**Net**	

DRIVING	Time	Odom	% SOC	DC Ah	DC kWh	Amb temp	A/C temp	A/C>10 min
Start	8:30	344	100	NA	NA	68.8 F	NA	
Stop	10:40	393	0			78.5 F		**Min. A/C**
Net		49						

Distance	State of Charge		Notes / Deviations / Traffic / Weather / Performance
Miles	**Veh meter**	**Range meter**	
0	4.0		
5.1	3.5		
9	3.0		
11.5	2.5		
15.5	2.0		
23.9	1.5		
31	1.0		
34	0.5		
42	0.0		
			Total Miles 49.1
			Low charge light on at 44.4
			Low charge light flashing at 48.5

Accessories used:

Drive / Regen setting: E mode

Handling/Braking: handling normal / braking normal

Other comments:

Charger	Serial No.	AC meter#	BMI #
EVC-031	PO31	01 712 275	NA

CHARGING	Date	Time	AC kWh in	BMI kWh in	DC kWh in	DC Ah in	Amb temp	Volts
Start	09/05/2000	15:24		NA	NA	NA	78.5 F	NA
Stop	09/14/2000	9:00						
Net			26.5					

Comments:

POMONA DRIVING TEST DATA

Date	Vehicle	VIN last 6	Test	Driver	Data File/Project		Volts
09/06/2000	Veh 3	NA	UR3	Sanchez	USPS Project	Start	NA
Road Cond	Tire Press	Payload				Stop	
Dry	35	1245 lb				Net	

DRIVING	Time	Odom	% SOC	DC Ah	DC kWh	Amb temp	A/C temp	A/C>10 min
Start	9:00	393	100	NA	NA	76.5 F	NA	
Stop	10:56	436	0			82.9 F		Min. A/C
Net		43						

Distance	State of Charge		Notes / Deviations / Traffic / Weather / Performance
Miles	Veh meter	Range meter	
0	4.0		
5.1	3.5		
8.5	3.0		
11.5	2.5		
16.3	2.0		
25	1.5		
29.7	1.0		
31	0.5		
38.4	0.0		
			Total Miles 43.1
			Low charge light on at 39.8
			Low charge light flashing at 42.4

Accessories used:
Drive / Regen setting: E mode
Handling/Braking: handling normal / braking normal
Other comments:

Charger	Serial No.		AC meter#		BMI #			
EVC-032			01 378 518		NA			
CHARGING	Date	Time	AC kWh in	BMI kWh in	DC kWh in	DC Ah in	Amb temp	Volts
Start	09/06/2000	15:20		NA	NA	NA	90.9 F	NA
Stop	09/07/2000	9:00						
Net			29.97					

Comments:

POMONA DRIVING TEST DATA

Date	Vehicle	VIN last 6	Test	Driver	Data File/Project		Volts
09/08/2000	Veh 4	NA	USPS	Sanchez	USPS Project	**Start**	NA
Road Cond	**Tire Press**	**Payload**				**Stop**	
Dry	35	1245 lb				**Net**	

DRIVING	Time	Odom	% SOC	DC Ah	DC kWh	Amb temp	A/C temp	A/C>10 min
Start	12:15	346	100	NA	NA	89.2 F	NA	
Stop	16:50	383	0			90.0 F		**Min. A/C**
Net								

Distance	State of Charge		Notes / Deviations / Traffic / Weather / Performance
Miles	**Veh meter**	**Range meter**	
0	4.0		
6.5	3.5		
7.8	3.0		
10.9	2.5		
15.2	2.0		
18.8	1.5		
23.4	1.0		
25.9	0.5		
28.9	0.0		
			Total Miles 37.7
			Low charge light on at 30.8
			Low charge light flashing at 33.2
			Power limit

Accessories used:

Drive / Regen setting: E mode

Handling/Braking:

Other comments:

Charger	Serial No.		AC meter#		BMI #			
EVC-016			620		1			
CHARGING	**Date**	**Time**	**AC kWh in**	**BMI kWh in**	**DC kWh in**	**DC Ah in**	**Amb temp**	**Volts**
Start	09/08/2000	4:55			NA	NA	90	NA
Stop	09/13/2000	9:00						
Net			31.51					

Comments:

POMONA DRIVING TEST DATA

Date	Vehicle	VIN last 6	Test	Driver	Data File/Project		Volts
09/11/2000	Veh 4	NA	USPS	Sanchez	USPS Project	**Start**	NA
Road Cond	**Tire Press**	**Payload**				**Stop**	
Dry	35	1245 lb				**Net**	

DRIVING	Time	Odom	% SOC	DC Ah	DC kWh	Amb temp	A/C temp	A/C>10 min
Start	9:30	383	100	NA	NA	81.3 F	NA	
Stop	13:30	416	0			93.7 F		**Min. A/C**
Net		33						

Distance	State of Charge		Notes / Deviations / Traffic / Weather / Performance
Miles	**Veh meter**	**Range meter**	
0	4.0		
5.4	3.5		
7.7	3.0		
10.7	2.5		
15	2.0		
18.3	1.5		
212	1.0		
23.3	0.5		
26	0.0		
			Total Miles 33
			Low charge light on at 27.7
			Low charge light flashing at 32.2

Accessories used:
Drive / Regen setting: E mode
Handling/Braking:
Other comments:

Charger	Serial No.		AC meter#		BMI #			
EVC-016	PO53		620		1			
CHARGING	**Date**	**Time**	**AC kWh in**	**BMI kWh in**	**DC kWh in**	**DC Ah in**	**Amb temp**	**Volts**
Start	09/11/2000	13:35			NA	NA	100.4 F	NA
Stop	09/12/2000	9:00						
Net			30.47					

Comments:

POMONA DRIVING TEST DATA

Date	Vehicle	VIN last 6	Test	Driver	Data File/Project		Volts
08/29/2000	Veh 4	NA	UR1	Sanchez	USPS Project	**Start**	NA
Road Cond	**Tire Press**	**Payload**				**Stop**	
Wet/Dry	35	245 lb				**Net**	

DRIVING	Time	Odom	% SOC	DC Ah	DC kWh	Amb temp	A/C temp	A/C>10 min
Start	9:50	255	100	NA	NA	68.1 F	NA	
Stop	12:04	300	0			70.3 F		**Min. A/C**
Net		45						

Distance	State of Charge		Notes / Deviations / Traffic / Weather / Performance
Miles	**Veh meter**	**Range meter**	
0	4.0		
6	3.5		
10	3.0		
13.1	2.5		
17.2	2.0		
24.4	1.5		
28.5	1.0		
34.5	0.5		
39.8	0.0		
			Total Miles 45.2
			Low charge light on at 41.2
			Low charge light flashing at 44.7

Accessories used: __________
Drive / Regen setting: E mode
Handling/Braking: Handling normal / Braking normal
Other comments: __________

Charger	Serial No.		AC meter#		BMI #			
EVC-016	PO53		02 069 250		NA			
CHARGING	**Date**	**Time**	**AC kWh in**	**BMI kWh in**	**DC kWh in**	**DC Ah in**	**Amb temp**	**Volts**
Start	08/29/2000	12:43			NA	NA		NA
Stop	09/12/2000	9:00						
Net								

Comments: __________

POMONA DRIVING TEST DATA

Date	Vehicle	VIN last 6	Test	Driver	Data File/Project		Volts
08/31/2000	Veh 4	NA	UR3	Sanchez	USPS Project	**Start**	NA
Road Cond	**Tire Press**	**Payload**				**Stop**	
Dry	35	1245 lb				**Net**	

DRIVING	Time	Odom	% SOC	DC Ah	DC kWh	Amb temp	A/C temp	A/C>10 min
Start	9:25	300	100	NA	NA	70.5 F	NA	
Stop	11:20	343	0			76.0 F		**Min. A/C**
Net		43						

Distance	State of Charge		Notes / Deviations / Traffic / Weather / Performance
Miles	**Veh meter**	**Range meter**	
0	4.0		
5.6	3.5		
9.3	3.0		
11.3	2.5		
16.1	2.0		
24	1.5		
29	1.0		
32.4	0.5		
34.5	0.0		
			Total Miles 43.7
			Low charge light on at 35.2
			Low charge light flashing at 42.6

Accessories used: ______

Drive / Regen setting: E mode

Handling/Braking: Handling normal / Braking normal

Other comments: ______

Charger	Serial No.		AC meter#		BMI #			
EVC-016	PO53		02 069 250		NA			
CHARGING	**Date**	**Time**	**AC kWh in**	**BMI kWh in**	**DC kWh in**	**DC Ah in**	**Amb temp**	**Volts**
Start	08/31/2000	11:24			NA	NA		NA
Stop	09/01/2000	9:00						
Net			29.96					

Comments: ______

APPENDIX B: MAGNETIC FIELDS ON EV AND GV WHILE DRIVING

5 Percentile (unit: mG)

Chest	Stop & Go	20 ~ 30 mph	30~40 mph
EV	0.14	0.17	0.14
GAS	0.17	0.16	0.17

Waist	Stop & Go	20 ~ 30 mph	30~40 mph
EV	0.14	0.17	0.17
GAS	0.14	0.14	0.17

Front Center	Stop & Go	20 ~ 30 mph	30~40 mph
EV	0.25	0.25	0.25
GAS	0.17	0.14	0.17

50 Percentile (unit: mG)

Chest	Stop & Go	20 ~ 30 mph	30~40 mph
EV	0.25	0.25	0.30
GAS	0.17	0.17	0.25

Waist	Stop & Go	20 ~ 30 mph	30~40 mph
EV	0.25	0.25	0.30
GAS	0.17	0.17	0.34

Front Center	Stop & Go	20 ~ 30 mph	30~40 mph
EV	0.25	0.41	0.38
GAS	0.17	0.17	0.25

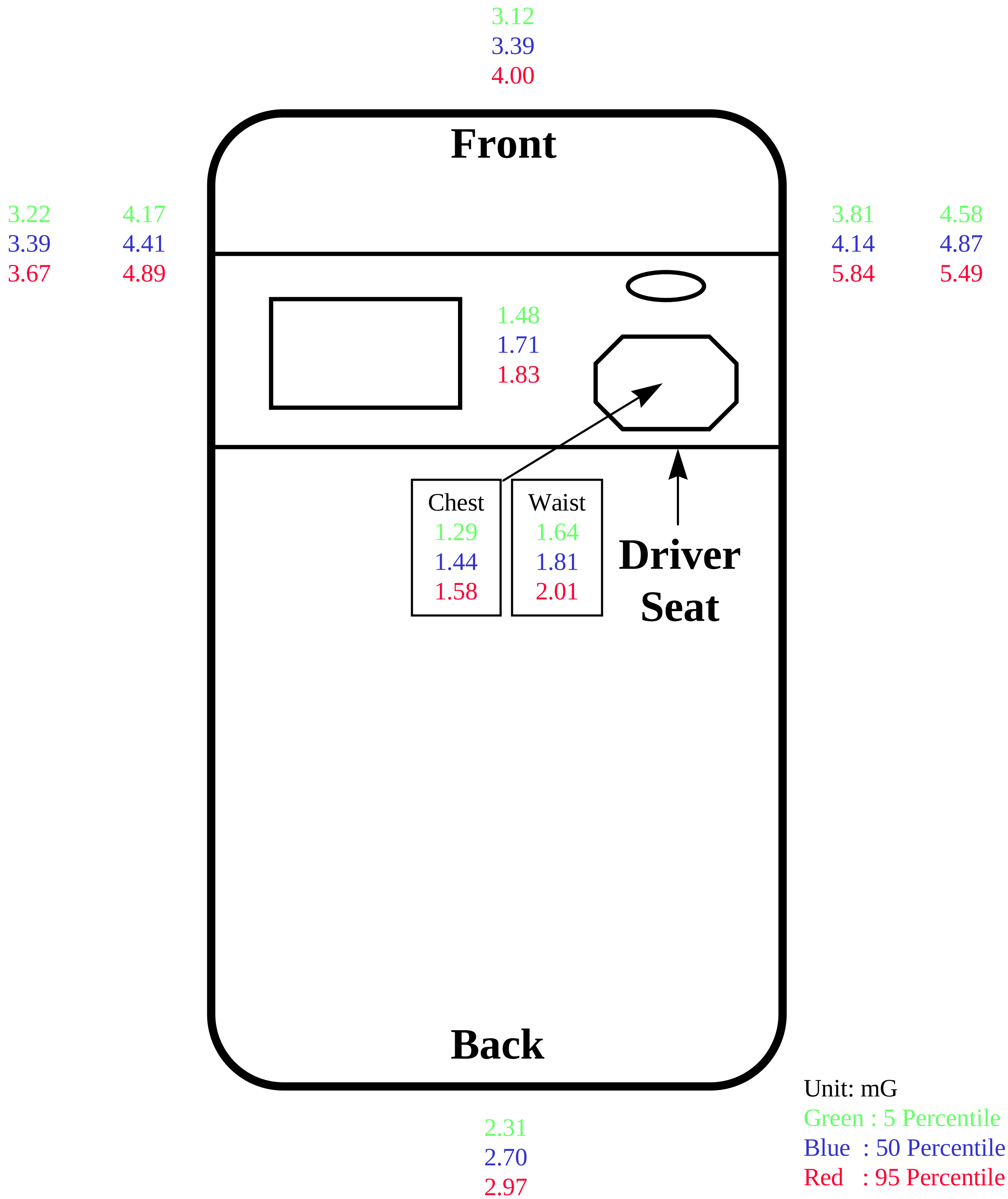
95 Percentile (unit: mG)

Chest	Stop & Go	20 ~ 30 mph	30~40 mph
EV	0.68	0.54	1.06
GAS	0.44	1.23	1.23

Waist	Stop & Go	20 ~ 30 mph	30~40 mph
EV	0.56	0.48	1.20
GAS	0.46	0.46	1.44

Front Center	Stop & Go	20 ~ 30 mph	30~40 mph
EV	1.44	0.84	0.98
GAS	0.43	0.31	0.93

APPENDIX C: MAGNETIC FIELDS ON EV WHILE CHARGING



APPENDIX D: TESTING PHOTOS

Photo 1: Meter Locations for the Driver

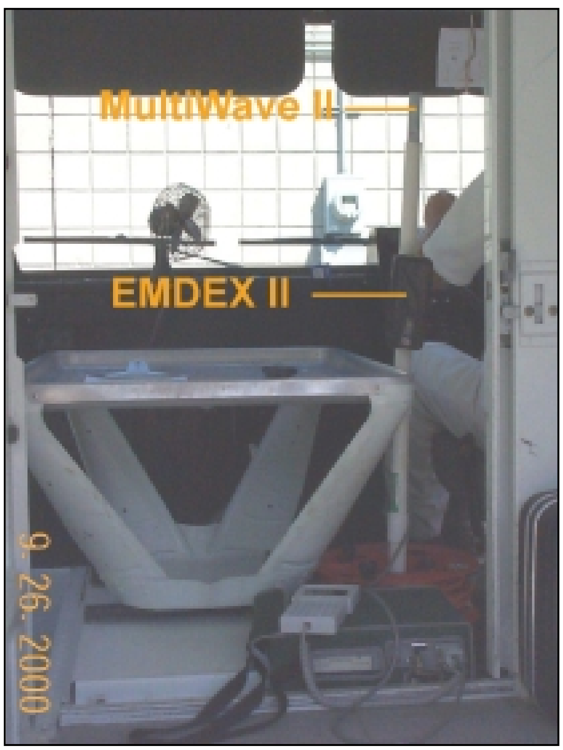


Photo 2 : MultiWave II and EMDEX II Locations

Photo 3 : EMDEX C Locations (Front of EV)

Photo 4 : EMDEX C Locations (Right Side)

Photo 5 : EMDEX C Locations (Left Side)

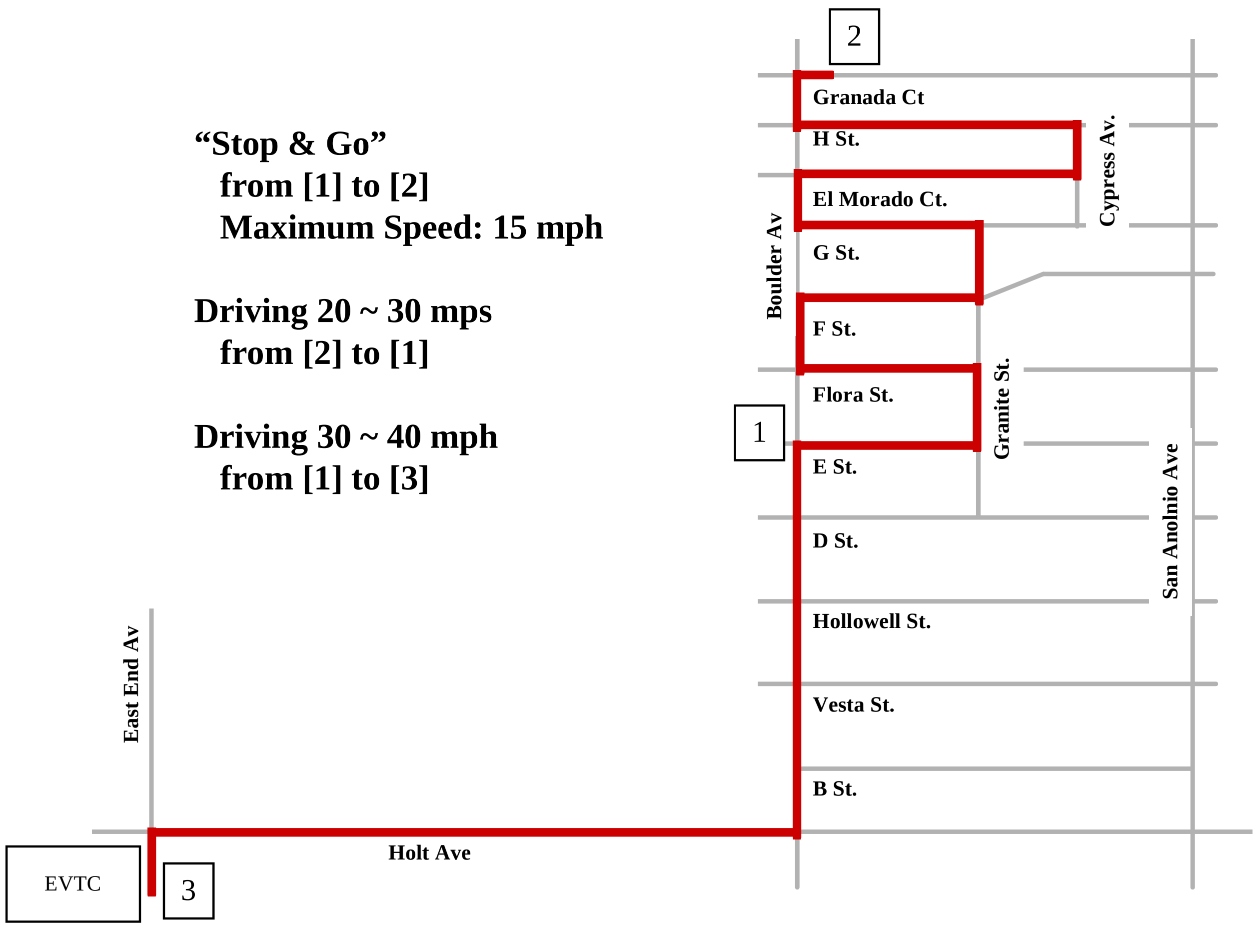
Photo 6 : EMDEX C Location (Back)

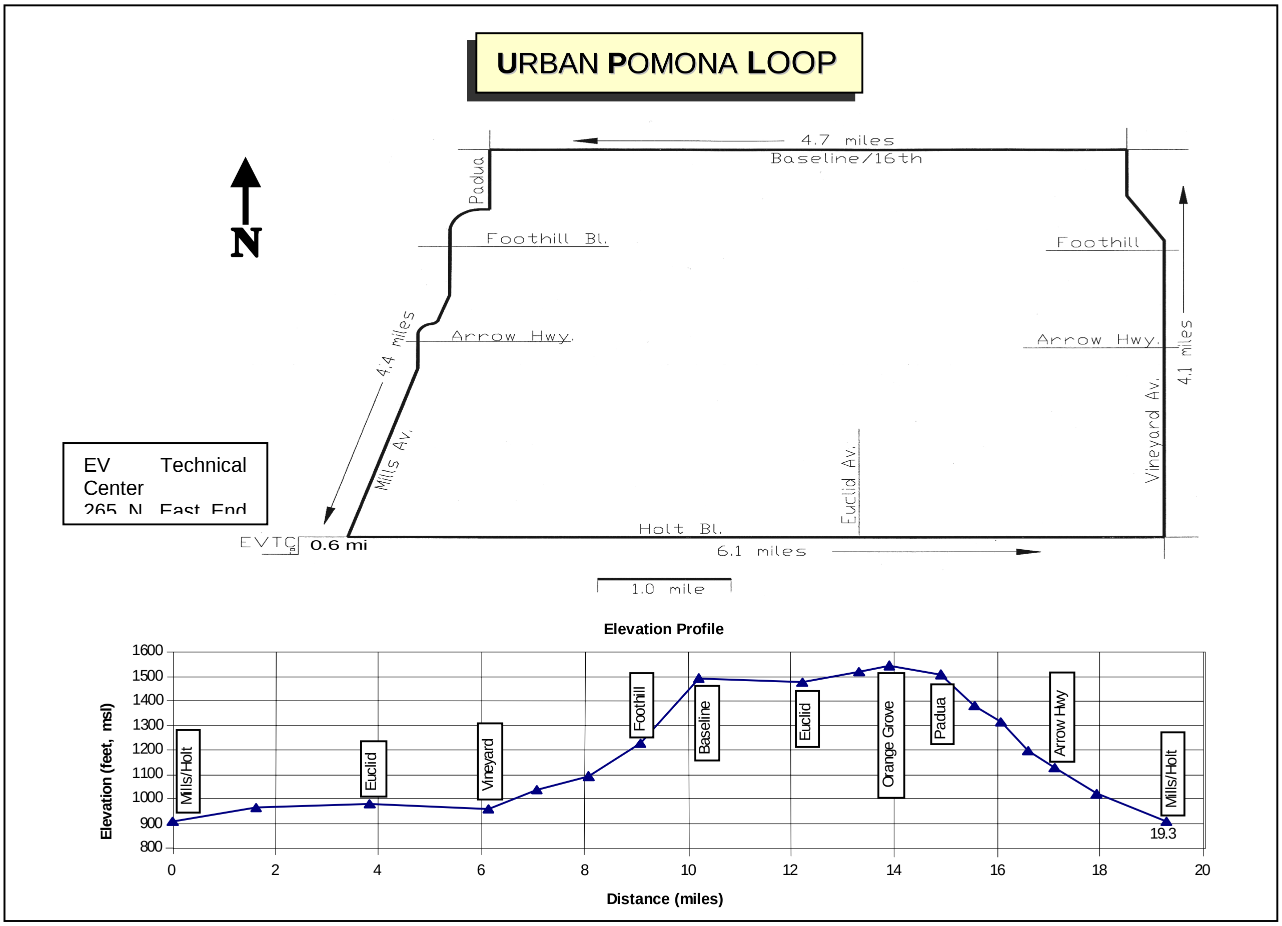
Photo 7 : Payload of 1000 lbs

Photo 8 : Water Test Setup

APPENDIX E: USPS DELIVERY ROUTE AND POMONA LOOP MAPS

USPS Delivery Route




URBAN POMONA LOOP
N
4.7 miles
Baseline/16th
Padua
Foothill Bl.
Foothill
4.4 miles
Arrow Hwy.
Arrow Hwy.
4.1 miles
Mills Av.
Vineyard Av.
Euclid Av.
EV Technical Center 265 N. East End
EVTC
0.6 mi
Holt Bl.
6.1 miles
1.0 mile
Elevation Profile
Elevation (feet, msl)
Distance (miles)
Mills/Holt
Euclid
Vineyard
Foothill
Baseline
Euclid
Orange Grove
Padua
Arrow Hwy
Mills/Holt
19.3