1999
EV AMERICA
TECHNICAL
SPECIFICATIONS

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Prepared by
Electric Transportation Applications

MINIMUM VEHICLE REQUIREMENTS

For a vehicle to be considered qualified as an EV America-USDOE "Production" level vehicle, it must meet the minimum criteria defined by "shall" terminology utilized in the Specification. [For clarity, the use of the word "Shall" defines minimum requirements, whereas the use of the word "Should" defines design and performance objectives.] Vehicles which cannot meet all of the "Shall" requirements will be considered Prototypes, and will not be considered as having "passed" EV America. The following requirements shall be met by any vehicle before it can receive EV America "Production" level status:

(1) Vehicles shall have a minimum payload of 400 pounds.

(2) For Conversion vehicles, OEM GVWR shall not be increased. Suppliers shall provide the OEMs Gross Vehicle Weight Rating (GVWR).

(3) For conversion vehicles, OEM Gross Vehicle Axle Weight Ratings (GAWR) shall not be increased. Suppliers shall provide axle weights for the vehicle as delivered, and at full rated payload.

(4) Seating capacity shall be a minimum of 2, (one driver and at least one passenger). Suppliers shall provide seating capacity (available seat belt positions) for their vehicle.

(5) Suppliers shall provide information on their selected battery manufacturer's recycling plan, including how it has been implemented.

(6) For conversion vehicles, the OEM passenger space shall not be intruded upon by the battery, battery box or other conversion materials.

(7) Vehicles shall comply with the requirements of 49 CFR 571.105.S5.2.1, or alternatively, 49 CFR 571.105.S5.2.2 for parking mechanisms.

(8) Vehicles shall have a minimum range between charges of at least 50 miles when loaded with two 166-pound occupants and operated at a constant 45 mph.

(9) Vehicles shall comply with Federal Motor Vehicle Safety Standards applicable on the date of manufacture and such compliance shall be certified by the manufacturer in accordance with 49 CFR 567. Suppliers shall provide a completed copy of Appendix B with their submittal, indicating the method of compliance with each section of 49 CFR 571. If certification includes exemption, the exemption number issued by the National Highway Transportation Safety Administration (NHTSA), the date of it's publication in the Federal Register and the page number(s) of the Federal Register acknowledging issuance of the exemption shall be provided along with Appendix B. Only exemptions for non-applicable requirements shall be allowed.

(10) Batteries and/or battery enclosures shall be designed and constructed in accordance with the requirements of SAE J1766 FEB96. Further, batteries and electrolyte will not intrude into the passenger compartment during or following FMVSS frontal barrier, rear barrier and side impact collisions, and roll-over requirements of 49 CFR 571.301. Suppliers shall provide verification of conformance to this requirement.

(11) Batteries shall comply with the requirements of SAE J1718 APR97, and at a minimum shall meet the requirements of NEC 625 for charging in enclosed spaces without a vent fan.

(12) Concentrations of explosive gases shall not be allowed to exceed 25% of the LEL (Lower Explosive Limit) in the battery enclosure. Suppliers shall describe how battery boxes will be vented, to ensure any battery gases escape safely to atmosphere during and following normal or abnormal charging and operation of the vehicle.

(13) The battery charger shall be capable of recharging the main propulsion battery to a state of full charge from any possible state of discharge in less than 12 hours, at temperatures noted in Section 5.6.

(14) Chargers shall have the capability of accepting input voltages of 208V and 240V single phase 60 Hertz alternating current service, with a tolerance of ±10% of rated voltage. Charger input current shall be compatible with the requirements for Level II chargers, and shall comply with the requirements of SAE J1772 OCT96 and/or SAE J1773 JAN95. Personnel protection systems shall be in accordance with the requirements of UL Standard 2202, Published 1998.

(15) Chargers shall have a true power factor of .95 or greater and a harmonic distortion rated at ≤ 20% (current at rated load).

(16) The charger shall be fully automatic, determining when “end of charge” conditions are met and transitioning into a mode that maintains the main propulsion battery at a full state of charge while not overcharging it, if continuously left on charge.

(17) Vehicles shall not contain exposed conductors, terminals, contact blocks or devices of any type that create the potential for personnel to be exposed to 50 volts or greater (the distinction between low-voltage and high voltage, as specified in SAE J1127 JAN95, J1128 JAN95, et al.).

(18) Vehicles being tested shall be accompanied by non-proprietary manuals for parts, service, operation and maintenance, interconnection wiring diagrams and schematics, (with pricing for optional manuals). These documents shall either be provided or available to the end user.

(19) The vehicle shall include a state of charge indicator for the main propulsion batteries.

20) Propulsion power shall be isolated from the vehicle chassis such that battery leakage current is less than 0.5 MIU in accordance with UL Standard 2202, Published 1998.

(21) Charging circuits shall be isolated from the vehicle chassis such that ground current from the grounded chassis at any time while the vehicle is on charge or the charger is connected to an off-board power supply does not exceed 5 mA, in accordance with UL Standards 2202, Published 1998.

(22) Replacement tires shall be commercially available to the end user in sufficient quantities to support the purchaser's needs,

(23) The vehicle shall prevented from being driven with the key turned on and the drive selector in the DRIVE or REVERSE position while the vehicle's charge cord is attached. Additionally, the following interlocks shall be present:

- The controller shall not initially energize to move the vehicle with the gear selector in any position other than "PARK" or "NEUTRAL;"
- The start key shall be removable only when the "ignition switch" is in the "Off" position, with the drive selector in "PARK;"
- With a pre-existing accelerator input, the controller shall not energize or excite such that the vehicle can move under its own power from this condition.

(24) All vehicles shall comply with the FCC requirements for unintentional emitted electromagnetic radiation, as identified in 47 CFR 15, Subpart B, "Unintentional Radiators."

(25) Failure of a battery or battery pack shall be determined through a discharge test. The discharge test shall be performed with the discharge current regulated to achieve a C/1 discharge rate based on the ampere hour capacity of the battery specified by the Supplier as required in Section 6.1 and with a battery temperature of at least 77º F. Subsequent to receiving a full charge and equalization, the battery shall be discharged at such current and temperature until the terminal voltage of any cell in the battery drops below the voltage specified by the Supplier as required in Section 6.3. The ampere hours delivered by the battery to that point shall be calculated and shall become the actual battery capacity. Failure of the battery shall be deemed to have occurred if the actual battery capacity is not at least 80% of the nominal ampere hour capacity specified by the Supplier as required by Section 6.1.

(26) Vehicles shall be equipped with an automatic disconnect for the main propulsion batteries. They shall also have a manual service disconnect. These disconnects shall be clearly labeled. [See Section 7.3]

(27) Any conductive or inductive type charging systems shall be compatible with the Personnel Protection requirements of SAE J1772 or J1773, as appropriate.

(28) Suppliers shall provide Material Safety Data Sheets (MSDS) for all batteries.

(29) Suppliers shall indicate the level of charge below which the batteries should not be discharged and how the controller automatically limits battery discharge below this level.

(30) Suppliers shall verify that the method(s) of charging the propulsion batteries and the charging algorithm have been reviewed and approved by the battery manufacturer.

(31) Regardless of the charger type used, the charger shall be capable of meeting the requirements of Section 625 of the National Electric Code (NEC).

(32) If the vehicle is equipped with fuel fired heaters, the vehicle shall comply with the requirements of 49 CFR 571.301.

(33) The vehicle shall have an on-board Battery Management System (BMS).

The following sections constitute the Technical Requirements of the Specification. Information has been categorized according to component and/or function. These sections provide an overview of the requirements and recommendations for Suppliers to use. This Technical Specification establishes the minimum requirements for Production level electric vehicles, as well as identifying design and performance objectives. Suppliers shall clearly describe the vehicle they are proposing by completing a copy of Appendix A. Drawings should be provided showing the installation, location and layout of the conversion components including the batteries, motor and controller, and powered accessories. The drive line should also be described, i.e., direct drive transmission, reduction gear ratio, etc.. Suppliers should include any other information required to describe the vehicle.

No inference should be drawn by Suppliers or any other person that the measures listed in this specification are sufficient to make the vehicle safe, and each Supplier shall acknowledge **in writing** that 1) it is solely responsible for determining whether each vehicle offered for sale is safe, and 2) it is not relying on EV America, Electric Vehicle Market Development Group (EVMDG), the Procurement Management Board (PMB), or any of the EV America participants, their Consultants, or the U.S. Government as having, by this specification and its requirements, established minimally sufficient safety standards. This written statement shall be provided in the Supplier’s proposal.

1.0 REGULATORY REQUIREMENTS

1.1 FMVSS CERTIFICATION

Vehicles shall comply with Federal Motor Vehicle Safety Standards applicable on the date of manufacture and such compliance shall be certified by the manufacturer in accordance with 49 CFR 567. Suppliers shall provide a completed copy of Appendix B with their proposal, indicating the method of compliance with each required section of 49 CFR 571. If certification includes exemption, the exemption number issued by the National Highway Transportation Safety Administration (NHTSA), the date of it's publication in the Federal Register and the page number(s) of the Federal Register acknowledging issuance of the exemption shall be provided along with Appendix B. Exemptions for any reason other than non-applicability shall not be allowed.

1.2 ZEV CERTIFICATION

Vehicles should be certifiable under current California Air Resources Board (CARB) regulations as zero-emission vehicles. Further, the vehicle should conform to Environmental Protection Agency (EPA) requirements for receiving a ZEV Certificate of Conformity. If the vehicle is equipped with a fuel-fired heater, the heater should also meet this requirement. If the vehicle is certified as other than ZEV (e.g., SULEV), similar documentation should be provided.

1.3 SAFETY FEATURES

Suppliers should describe safety measures and safety-related design features included in their vehicle design and provide an explanation of the purpose and anticipated effect on vehicle reliability and performance of any such safety measure or design feature.

1.4 MATERIAL SAFETY DATA SHEETS

Suppliers shall supply Material Safety Data Sheets (MSDS) for all batteries the vehicle is equipped with, including auxiliary batteries.

1.5 BATTERY RECYCLING PLANS

Suppliers shall provide information on their selected battery manufacturer's recycling plan including how it has been implemented. This plan should also identify post-purchase costs associated with recycling that will be passed on to the vehicle purchaser.

1.6 FEDERAL COMMUNICATIONS REQUIREMENTS

All vehicles shall comply with the FCC requirements for unintentional emitted electromagnetic radiation, as identified in 47 CFR 15, Subpart B, "Unintentional Radiators."

2.0 CHASSIS

2.1 RATED PAYLOAD

Vehicles shall have a minimum payload of 400 pounds. The preferred rated payload for pickups should be two (2) 166-pound occupants plus a 300 pound payload (632 lbs total). The preferred rated payload for sedans is four (4) 166-pound occupants.

2.2 CURB WEIGHT AND GROSS VEHICLE WEIGHT RATING (GVWR)

For conversions, OEM GVWR shall not be increased. Suppliers should provide the curb weight and rated payloads of their vehicles. For conversion vehicles, Suppliers shall specify the OEMs gross vehicle weight rating (GVWR).

2.3 VEHICLE WEIGHT DISTRIBUTION

For conversions, OEM Gross Vehicle Axle Weight Ratings (GAWR) shall not be increased. Suppliers shall provide axle weights for the vehicle as delivered, and at full rated payload.

2.4 SPEEDOMETER AND ODOMETER

Speedometers and odometers should have an accuracy of at least $\pm$ 5%.

2.5 BRAKING AND STEERING PERFORMANCE

Braking and steering efforts should be similar to OEM models of comparable size and weight that are equipped with power brakes and power steering.

2.6 TIRES

Tires shall be subject to the following requirements:

- Tires provided with the vehicle shall be the standard tire offered by the EV manufacturer for the vehicle being proposed.
- Tires shall correspond to the requirements of the placard installed in accordance with 49 CFR 571.109, 110, 119 and 120, as applicable.
- Suppliers shall specify manufacturer, model and size of the standard tire.
- Tires sizes and inflation pressures shall be in accordance with the requirements of the placard.
- At no time shall the tire’s inflation pressure exceed the maximum pressure imprinted upon that tire’s sidewall.
- The tire shall be operable across the entire operation/load range of that vehicle.
- Replacement tires shall be commercially available to the end user in sufficient quantities to support the purchaser’s needs.

2.6 TIRES (continued)

- Tires provided as original equipment by the EV manufacturer shall not have warranty restrictions in excess of those of the tire's manufacturer, unless the EV Manufacturer is the sole warrantor for the tires.

If the vehicle may be equipped with more than one standard tire, this information shall be provided for each type/manufacturer of each standard tire.

Additionally, the tires should meet the following:

- The standard tire should be a low-rolling-resistance tire.

2.7 GROUND CLEARANCE

Vehicles should have a ground clearance of at least five (5) inches to all sprung portions of the vehicle, with the vehicle loaded with rated payload.

3.0 VEHICLE CHARACTERISTICS

3.1 SEATING CAPACITY

Seating capacity shall be a minimum of 1 driver and 1 passenger and should be 1 driver and 3 passengers for sedans. Suppliers shall specify seating capacity (available seat belt positions) for their vehicle. If the vehicle's seating capacity is changed from that specified by the OEM on their FMVSS placard, the seat(s) being added or abandoned shall be modified as required by 49 CFR 571.207, et al, and a new FMVSS placard installed as required by 49 CFR 567, 568 or 571, as applicable.

3.2 PASSENGER AND CARGO SPACE

For conversion vehicles, the OEM passenger space shall not be intruded upon by the battery, battery box or other conversion materials. Suppliers should specify interior passenger and cargo dimensions and volumes.

3.3 ELECTROMAGNETIC SUSCEPTIBILITY

Vehicles should comply with the relevant sections of SAE J551 JUN94 for electromagnetic radiated fields. Vehicles should not be susceptible to externally generated electromagnetic radiation from an on-board transmitter (i.e., interaction will not render the vehicle un-safe or preclude operation of any systems required for safe operation of the vehicle).

Vehicles should be designed to minimize occupant exposure to electromagnetic fields generated by the propulsion system.

3.4 VEHICLE COLOR

Supplier's should specify what colors are available as options.

4.0 DRIVE SYSTEM

4.1 TRANSMISSION

The vehicle should utilize a single speed or multi-speed automatic transmission and a parking mechanism.

4.2 REGENERATIVE BRAKING SYSTEM

Regenerative braking should not adversely impact the vehicle's braking ability on varying road surfaces. Suppliers should describe the operation of the regenerative braking system and it's interface with braking and anti-lock brake systems.

4.3 OVERHEATING

The vehicle motor and controller/inverter should be capable of continuous operation at maximum vehicle speed and/or sustained grades without overheating or loss of component life over the range of ambient temperatures specified in Section 5.6.

4.4 BATTERY VOLTAGE LIMITS

The controller/inverter shall limit the minimum traction battery discharge voltage to prevent degradation of battery life, and should limit the maximum regeneration voltage to prevent external gassing of the batteries. Suppliers should specify the voltage limits and describe how these limits are implemented.

4.5 DRIVE TRAIN

Drive train components should not produce or develop unusual vibrations over the entire design speed range of the vehicle.

4.6 PARKING MECHANISM

Vehicles shall comply with the requirements of 49 CFR 571.105.S5.2.1, or alternatively, 49 CFR 571.105.S5.2.2 for parking mechanisms.

5.0 VEHICLE PERFORMANCE

5.1 ACCELERATION

The vehicle should have a 0-50 mph acceleration time of 13.5 seconds or less when loaded with two 166-pound occupants and starting with batteries at a 50% State of Charge.

5.2 MINIMUM TOP SPEED

The vehicle should have a minimum top speed of 70 MPH when loaded with two 166-pound occupants and starting with batteries at a 50% state of charge.

5.3 HIGH SPEED GRADEABILITY[1]

Vehicles should achieve a minimum sustainable speed of 55 mph when loaded with two 166-pound occupants on a 3% grade, and 45 mph on a 6% grade, with batteries at a 50% state of charge. Additionally, the vehicle should be capable of maintaining a constant 55 mph on a 3% grade for a minimum of 15 minutes starting with batteries at a 50% State of Charge. The vehicle should have these capabilities whether using Level II or Level III Charging.

5.4 LOW SPEED GRADEABILITY

Vehicles should be capable of starting and ascending a 25% grade when loaded with two 166-pound occupants and at 50% state of charge.

5.5 RANGE BETWEEN CHARGES

5.5.1 LEVEL II CHARGING

When using Level II Charging and starting from a state of charge of 100%, vehicles shall have a minimum range between charges of at least 50 miles when loaded with two 166-pound occupants and operated at a constant 45 mph. Vehicles should have a range of at least 60 miles when subjected to the combined UDS-HWFET Drive Cycle (established in SAE J1634 MAY93) at an ambient temperature of 77° ±9°F.

5.5.2 LEVEL III CHARGING

When using a Level III charger and starting from a state of charge of 100%, vehicles shall have a minimum range between charges of at least 35 miles and a distance capability of at least 100 miles in any eight-hour period when operated at a constant 45 mph while loaded with two 166-pound occupants. Vehicles should have a range of at least 60 miles when subjected to the combined UDS-HWFET Drive Cycle (established in SAE J1634 MAY93) at an ambient temperature of 77° ±9°F.

[1] EV America performs a 3% Grade at 55mph Test (ETA-TP004), but does not perform a 6% Grade at 45mph Test. This is per agreement with California's Air Resource Board (CARB), South Coast Air Quality Management District (SCAQMD) and the California Energy Commission (CEC).

5.6 TEMPERATURE DURABILITY

Vehicles should be capable of standing for extended periods in extreme temperatures without damage to or failure of the vehicle or it's systems. This includes ambient air temperatures of -20°F to +120°F, paved surface temperatures greater than 150°F, and occupant compartment temperatures approaching 170°F.

5.7 WATER DURABILITY

Vehicles should be able to drive through two (2) inches of standing water at a speed of 20 mph without damage, without becoming inoperable, and without battery to chassis leakage current exceeding 0.5 MIU per UL Standard 2202.

Vehicles should be capable of setting in eight (8) inches of standing water for 15 minutes without damage, without becoming inoperable, and without battery to chassis leakage current exceeding 0.5 MIU per UL Standard 2202.

6.0 BATTERY

6.1 BATTERY TYPE

Suppliers should provide a detailed description of the main propulsion battery pack (including specific energy, specific power and discharge capacity to 80% DOD at the one-hour and three-hour rates), battery pack voltage, number of battery modules, and a summary of previous performance tests. Summary results of actual performance tests or computer simulations of the proposed battery in a compact pick-up or sedan should also be provided. If different, customer available and battery available DOD ratings shall both be provided.

6.2 BATTERY CHARACTERISTICS

Batteries shall comply with the requirements of SAE J1718 APR97. For valve regulated batteries, the internal pressure level at which batteries vent should be specified. Suppliers should describe projected charge cycles at a specified level of discharge, how battery life is maximized, how end of life of each battery module and of the full battery pack is determined and how battery temperature gradients are minimized. Suppliers should specify maximum normal and abnormal gassing rates for the battery pack.

Propulsion batteries shall meet the requirements of NEC 625 and UL-2202 for charging in enclosed spaces without a vent fan. The vehicle shall be labeled as not requiring ventilation for charging (or have the appropriate classification label from a UL-recognized Testing Laboratory).

6.3 MAXIMUM STATE OF DISCHARGE

Suppliers shall indicate the level of charge below which the batteries should not be discharged. This shall include the specific parameters the Battery Management System utilizes to prevent over-discharge. At a minimum the Ah rating(s), module voltage(s), and battery pack voltage(s) shall be provided. Further, this shall be consistent with information provided in the Owner's Manuals.

6.4 BATTERY PACK

Suppliers should specify the weight of each battery module, and the weight of the battery pack (including removable pack structures). Suppliers should describe how batteries are installed in the vehicle (including details of module connection), the method of installation and removal of the batteries (and the battery box, if required) for maintenance and repair, the time required for battery removal and any special training, tools or equipment required for battery removal.

6.5 ELECTROLYTE CONTAINMENT

Batteries and/or battery enclosures shall meet the requirements of SAE J1766 FEB96 and shall be designed and constructed in such a way that batteries and electrolyte will not intrude into the passenger compartment during or following FMVSS frontal barrier, rear barrier and side impact collisions, and roll-over requirements of 49 CFR 571.301. Suppliers shall provide verification of conformance to these requirements.

6.6 BATTERY BOX

Concentrations of explosive gases shall not be allowed to exceed 25% of the LEL (Lower Explosive Limit) in the battery box. Suppliers shall describe how battery boxes will be vented, to allow any battery gases to escape safely to atmosphere during and following normal or abnormal charging and operation of the vehicle. Suppliers shall provide a verification of conformance to SAE J1718 APR97 on Battery Gas Evolution.

Suppliers should describe the methods used to prevent or accommodate condensation in the battery box, and the quantity and maximum rate of explosive gas generation, by gas type, under normal and abnormal charging conditions.

6.7 PARALLEL BATTERY PACKS

Suppliers should not provide vehicles with parallel battery packs. If a Supplier provides a vehicle with parallel battery packs, the Supplier should provide detailed information on the equipment and charging algorithms required to prevent the parallel strings from becoming unbalanced.

6.8 BATTERY MAINTENANCE

Maintenance requirements for the propulsion batteries should be described and any associated cost(s) to the consumer/end user should be clearly defined.

6.9 BATTERY FAILURE DETERMINATIONS

Failure of a battery or battery pack shall be determined through a discharge test. The discharge test shall be performed with the discharge current regulated to achieve a 1C discharge rate based on the ampere hour capacity of the battery specified by the Supplier as required in Section 6.1 and with a battery temperature of at least 77º F. Subsequent to receiving a full charge and equalization, the battery shall be discharged at such current and temperature until the terminal voltage of any cell in the battery drops below the voltage specified by the Supplier as required in Section 6.3. The ampere hours delivered by the battery to that point shall be calculated and shall become the actual battery capacity. Failure of the battery shall be deemed to have occurred if the actual battery capacity is not at least 80% of the nominal ampere hour capacity specified by the Supplier as required by Section 6.1.

6.10 BATTERY CHARGING ALGORITHM

Suppliers shall verify that the method(s) of charging the propulsion batteries and the charging algorithm(s) have been reviewed and approved by the battery manufacturer. This applies for all types of charging the vehicle is capable of.

6.11 BATTERY MANAGEMENT SYSTEM

The vehicle shall be equipped with a Battery Management System (BMS). This system should control propulsion battery pack and module voltages, temperatures and state of charge. Further, the BMS shall automatically limit battery discharge below a pre-determined minimum level. Manufacturer's shall provide a description of the BMS' operation. This description shall be consistent with that provided in the owner's manual.

The charger system should include equipment to maintain each module in the battery pack at equal temperature and within the allowed temperature range of the battery throughout each charge-discharge cycle.[2]

[2] Other certifying or qualifying agencies, such as California's South Coast Air Quality Management District (SCAQMD) and the California Energy Commission (CEC), may have requirements for maintaining battery temperatures that differ from EV America. Should bidders wish to be considered under those qualification and/or incentive programs using EV America data, those entities should be consulted.

7.0 ELECTRICAL

7.1 ELECTRICAL SAFETY

Vehicles shall not contain exposed conductors, terminals, contact blocks or devices of any type that create the potential for personnel to be exposed to 50 volts or greater (the distinction between low-voltage and high voltage, as specified in SAE J1127, J1128, et al.). Access to any high voltage components shall require the removal of at least one bolt, screw, or latch. Devices considered to be high voltage components shall be clearly marked as HIGH VOLTAGE. These markings should be installed at any point the voltage can be accessed by the end user. Additionally, cable and wire marking shall consist of orange wire and/or orange sleeving as identified in SAE-J1127 MAR88.

7.2 ELECTRICAL ISOLATION

Propulsion power shall be isolated from the vehicle chassis such that leakage current does not exceed 0.5 MIU. Charging circuits shall be isolated from the vehicle chassis such that ground current from the grounded chassis does not exceed 5 mA at any time the vehicle is connected to an off-board power supply. Supplier should provide details on grounding and isolation methods.

7.3 BATTERY DISCONNECT

Vehicles shall be equipped with an automatic disconnect for the main propulsion batteries. The disconnect shall operate to isolate the propulsion circuits any time the chassis becomes energized from contact with the propulsion battery or its associated circuits. This disconnect shall be capable of interrupting maximum rated controller/inverter current. The Supplier shall describe the automatic disconnect provided for the main propulsion batteries.

A manual service disconnect shall also be required. A decal or other label denoting the location of the device should be affixed to the driver's sun visor. A similar decal should be affixed to the inside of the vehicle such that it is visible to individuals located outside the vehicle through the lower left-hand corner of the rear window. The requirements for visibility and labeling should be the same as those denoted in 49 CFR 565.

This disconnect should be operable from the driver's seated position. It shall require the following capabilities:

- Manual action to break the connection
- The disconnection is physically verifiable
- The disconnection does not create exposed conductors capable of becoming energized while exposed.

7.3 BATTERY DISCONNECT (continued)

Alternately, the key-switch may be used to satisfy the operability portion of the manual service disconnect requirement, if it interrupts all control power going to the controller and the main battery contactor(s). This disconnect is not required to operate under load.

7.4 SAFETY INTERLOCK SYSTEM

The vehicle shall be prevented from being driven with the key turned on and the drive selector in the drive or reverse position while the vehicle's charge cord is attached. Additionally, the following interlocks shall be present:

- The controller shall not initially energize to move the vehicle with the gear selector in any position other than "PARK" or "NEUTRAL;"
- The start key shall be removable only when the "ignition switch" is in the FF" position, with the drive selector in "PARK;"
- With a pre-existing accelerator input, the controller shall not energize or excite such that the vehicle can move under its own power from this condition.

7.5 OPERATION OF HAZARD LIGHTS

Hazard lights should be capable of at least one hour of continuous operation in the event of shutdown or isolation of the main battery pack or failure of the DC/DC converter system.

7.6 STATE OF CHARGE INDICATOR

The vehicle shall include a state of charge indicator for the main propulsion batteries. Indications should be accurate to ± 5% of full scale.

7.7 CONNECTORS

Low voltage connectors should meet the requirements of applicable SAE Standards, including J163, J561, J858, et al. High voltage connectors should utilize locking devices, should be keyed to prevent mis-connection, and should be moisture proof.

8.0 CHARGER SYSTEM

8.1 LEVEL II CHARGING

8.1.1 CHARGER OPERATION

Vehicles shall be equipped with a battery charger capable of recharging the main propulsion battery to a state of full charge from any possible state of discharge in less than 12 hours,[3] assuming that recharging occurs with supply power at 208V single phase 40A maximum, at temperatures noted in Section 5.6. The preferred recharge time should be less than eight (8) hours.

The charger should maintain each battery module at a consistent state of charge over the life cycle of the battery. The charger should not charge the batteries in a manner that would cause venting of gas or liquid. The charger shall be fully automatic, determining when "end of charge" conditions are met and transitioning into a mode that maintains the main propulsion battery at a full state of charge while not overcharging it, if continuously left on charge. The charger should also minimize the energy required to maintain the main propulsion battery in a fully charged state, particularly during extended periods on charge.

8.1.2 CHARGING INPUT POWER

Chargers shall have the capability of accepting input voltages of 208V and 240V single phase 60 Hertz alternating current service, with a tolerance of ±10% of rated voltage. Charger input current shall be compatible with 40 ampere circuit breakers. On-board personnel protection systems, which may include ground fault circuit interrupters (GFCI), shall be in accordance with the provisions of UL Standards 2202. Any conductive or inductive type charging systems shall be in accordance with the requirements of SAE J1772 or J1773.

8.1.3 POWER QUALITY

Chargers shall have a true power factor of .95 or greater and a harmonic distortion of the current of ≤ 20%, when operating at rated load.

8.1.4 VEHICLE CHARGER CONNECTIONS

Suppliers should describe the type, size and location of the point of the vehicle charging port. The charge connector should comply with the requirements of SAE J1772 or SAE J1773, as appropriate. Regardless of the charger type used, the charger shall conform to the requirements of UL Proposed Standard 2202.

[3] Other certifying or qualifying agencies, such as California's South Coast Air Quality Management District SCAQMD) and the California Energy Commission (CEC), may have requirements for charging times that differ from EV America. Should bidders wish to be considered under those qualification and/or incentive programs using EV America data, those entities should be consulted.

8.2 LEVEL III CHARGING

8.2.1 CHARGER OPERATION

if the vehicle is equipped for fast charging the battery charger shall be capable of recharging the main propulsion battery in time's specified in Section 9.7.[4]

The charger should maintain each battery module at a consistent state of charge over the life cycle of the battery. The charger should not charge the batteries in a manner that would cause venting of gas or liquid. The charger shall be fully automatic, determining when "end of charge" conditions are met and terminating the charge.

8.2.2 CHARGING INPUT POWER

Chargers shall have the capability of accepting input voltages of 240V and 480V three phase 60 Hertz alternating current service, with a tolerance of ±10% of rated voltage. Charger personnel protection systems shall be in accordance with the provisions of UL Standard 2202. Charging systems shall be in accordance with the requirements of SAE J1772 or SAE J1773, and UL2202.

8.2.3 POWER QUALITY

Chargers shall have a true power factor of .95 or greater and a harmonic distortion of the current of ≤ 20%, when operating at rated load.

8.2.4 VEHICLE CHARGER CONNECTIONS

Suppliers should describe the type, size and location of the point of the vehicle charging port. The charge connector should comply with the requirements of SAE J1772 or J1773, as appropriate. Regardless of the charger type used, the charger shall conform to the requirements of UL Standard 2202.

[4] Other certifying or qualifying agencies, such as California's South Coast Air Quality Management District SCAQMD) and the California Energy Commission (CEC), may have requirements for charging times that differ from EV America. Should bidders wish to be considered under those qualification and/or incentive programs using EV America data, those entities should be consulted.

9.0 OPTIONS

Suppliers should describe the following options, which are to be priced separately from the base vehicle. The installation of options shall not relieve Suppliers of meeting other "shall" requirements (except for range). Suppliers should specify the impact on range and payload for each option. Suppliers are encouraged to include pricing and technical information on the following options.

9.1 AIR CONDITIONING SYSTEM

Suppliers should describe the design of the air conditioning system and verify that it uses no chloroflourocarbons (CFCs).

9.2 OCCUPANT COMPARTMENT PRE-HEATING AND COOLING SYSTEM

Suppliers should briefly describe the design of a pre-heating and pre-cooling system that allows passenger compartment temperatures to be maintained while the vehicle is on charge.

9.3 RANGE EXTENSION OPTIONS

Suppliers should describe options that increase the vehicle's range between recharges. Such options may include, but should not be limited to, advanced batteries and more efficient drive systems.

9.4 COLD WEATHER RANGE EXTENSION

Suppliers should describe the design of a system that will ensure a vehicle range of at least 50 miles at a constant speed of 45 mph with the vehicle operated in an outdoor ambient temperature that does not exceed 25°F after the vehicle has been parked for 48 hours at ambient 10°F with the vehicle plugged in. This system should operate concurrent with the charging system, and should not require the use of additional connection points. It should not require manual intervention, and should operate at all input voltages for which the charger is rated

9.5 PASSENGER COMPARTMENT HEATER

Suppliers should describe the design feature(s) that ensure the vehicle heating system is capable of maintaining interior temperatures of at least 65°F at an ambient temperature of 10°F. If fuel fired heaters are used, they shall meet the requirements of Section 1.2. Further, heater fuel containments shall meet the requirements of 49 CFR 571.301.

9.6 CONTROLLER/INVERTER MEASUREMENT SYSTEM

Suppliers should describe a diagnostic system for the controller/inverter.

9.7 FAST CHARGE CAPABILITY

Suppliers should describe a system that will allow the vehicle to be charged at a rate which will return 40% capacity in 15 minutes or less.[5] If the vehicle is fast-charge capable, it shall also meet the range and grade requirements previously specified. The manufacturer's description should include maximum current ratings of cables and associated components which may be affected by fast charging. If specific alterations to the vehicle are required, these should be identified along with the cost and time required to complete them.

9.8 120V CHARGER

Suppliers should make available a 120V charger, either as permanent installation or as a portable carry-on. This charger shall comply with the requirements of Section 7.2 for isolation and Section 8.3 for personnel protection. The charger should recharge the vehicle as quickly as possible from a 15A single phase breaker.[6]

9.9 AMMETER

Suppliers should offer an ammeter capable of providing an indication of the charging and discharging currents of the propulsion battery.

9.10 BATTERY VOLTAGE INDICATOR

The vehicle should include a battery system voltage indicator. Indication should be accurate to ± 2% of full scale.

9.11 AMP-HOUR INDICATOR

The vehicle should include at least one of the following devices:

- An amp-hour indicator which integrates on both charge and discharge
- A kilowatt meter capable of measuring power out of the main propulsion batteries

If an ammeter or kilowatt meter is used, it should also provide measurement of current or power. Regardless of the type chosen, it should be accurate to ± 2% of full scale.

[5] This value is consistent with the values identified by USABC and accepted by CARB.

[6] Other certifying agencies, such as California's South Coast Air Quality Management District (SCAQMD), may have requirements for 120V charging that exceed those of EV America. Should bidders wish to be considered under those qualification and/or incentive programs using EV America data, those entities should be consulted.

10.0 DOCUMENTATION

10.1 SERVICE MANUALS

Vehicles shall be accompanied by non-proprietary manuals for parts, service, operation and maintenance, interconnection wiring diagrams and schematics, (with pricing for optional manuals). Included should be details on the design and operation of vehicle systems, as well as prices and availability of parts and service and a list of additional or special maintenance tools required.

10.2 TRAINING PROGRAM

Suppliers should offer a training program for the purchaser's maintenance personnel covering vehicle safety and proper operation and maintenance of vehicles. Costs of this program should be included in the base price of the vehicle.

10.3 REGISTRATION DOCUMENTATION

Title and registration requirements vary significantly between states and commonwealths. To assure that a vehicle that has been purchased through EV America can be titled for use by the purchaser, the following documentation shall be provided with the vehicle at the time of sale:

- Manufacturer's Certificate of Origin (MCO) - a copy of the MCO provided to the converter by the OEM, as well as the Converters MCO shall be provided.
- Odometer Statement - An odometer statement shall be provided by the OEM and the Converter
- Invoice - A complete invoice for the vehicle. If the vehicle is a conversion, the converter's invoice shall clearly indicate the charges due to procurement of the vehicle prior to conversion, as well as the source of the vehicle.

The name of the converter shall be the registered name, and shall be used consistently throughout the documents. All signatures shall be followed with the individuals printed (not typed) name and printed title of the signer. This shall be applied throughout the document.

APPENDIX A

PERFORMANCE

Time required to accelerate from 0-50 on a level grade _____
Time required to accelerate from 0-55 on a 3% grade _____
Time required to accelerate from 0-45 on a 6% grade _____
Maximum speed attainable on a level grade _____
Maximum grade attainable from a standing start at GVWR _____
Range at a constant speed of 45 mph _____
Range over the SAE J1634 combined UDS-HWFET cycle _____

BATTERY CHARACTERISTICS (referenced to 77° F)

Manufacturer _____
Model _____
Type _____
Description _____
Number of Batteries in the Pack _____
Arrangement (series or parallel) _____
Battery module voltage _____
Battery pack voltage _____
Battery module weight _____
Battery pack weight _____
Maximum Normal Gassing Rate (scfm or cc/ml/m) _____
Maximum Abnormal Gassing Rate (scfm or cc/ml/m) _____
Battery amp-hour capacity to 100% Manufacturer's DOD, 1 hour rating_____
Battery amp-hour capacity to 100% Manufacturer's DOD, 2 hour rating_____
Battery amp-hour capacity to 100% Manufacturer's DOD, 3 hour rating_____
Battery watt-hour capacity to 100% Manufacturer's DOD, 1 hour rating_____
Battery watt-hour capacity to 100% Manufacturer's DOD, 2 hour rating_____
Battery watt-hour capacity to 100% Manufacturer's DOD, 3 hour rating_____
Probable life of an average battery (number of cycles) to a Manufacturer's DOD of:
To 50% _____
To 80% _____
Price of Replacement Batteries, per battery module ($) _____
Price of Replacement for entire battery pack ($) _____
Time Required to Recharge the batteries at 208V from a Customer's DOD of:
From 50% _____
From 80% _____

APPENDIX A (cont)

CHARGER CHARACTERISTICS

Manufacturer _____
Model _____
Description _____
Location _____
Charger Efficiency _____
Charger Input Voltages _____
Maximum Charger Current Output _____

MOTOR CHARACTERISTICS

Manufacturer _____
Model _____
Description _____
Type and Phase (AC, DC, Brushless, etc.)_____
kW Rating at Voltage and Current _____
Rated Efficiency at kW Output _____
Operating Range (RPM) _____
Maximum Continuous Current_____
Operating Temperature Range (°F) _____
Cooling Medium and Method_____

CONTROLLER CHARACTERISTICS

Manufacturer _____
Model _____
Description _____
Type and Phase_____
Input Voltage Range_____
Maximum Output Amps _____
Type of Power Electronics (SCR, mosfet, etc.) _____
Rated Efficiency (at current)_____

APPENDIX A (cont)

TRANSMISSION CHARACTERISTICS

Manufacturer _____
Type _____
Model _____
Description (Single Speed Manual, Automatic, Other) _____
Gear Ratio(s) _____
Estimated Efficiency Losses (including support systems) _____

CHASSIS CHARACTERISTICS - Pre-Conversion

Make, Year and Model (pre-conversion) _____
Gross Vehicle Weight Rating (GVWR) _____
Gross Axle Weight Rating (Front) _____
Gross Axle Weight Rating (Rear) _____
Curb Weight (as designed) _____
Weight Distribution (as designed)_____
Payload Capacity (as designed) _____
Ground Clearance from Lowest Point on Chassis at GVWR_____
Drive Wheels (F/R)_____

CHASSIS CHARACTERISTICS - Post-Conversion

Make, Year and Model _____
Gross Vehicle Weight Rating (GVWR) _____
Gross Axle Weight Rating (Front) _____
Gross Axle Weight Rating (Rear) _____
Curb Weight (as designed) _____
Weight Distribution (as designed)_____
Payload Capacity (as designed) _____
Ground Clearance from Lowest Point on Chassis at GVWR_____
Drive Wheels (F/R)_____

BRAKING

Type Front _____
Type Rear _____
Source of Vacuum (if used) _____
Average Power Required (watts) _____
Regenerative Braking _____

APPENDIX A (cont)

TIRES

Manufacturer _____
Model _____
Description _____
Size and Profile _____
Rolling Resistance Rating _____
Pressure, Front and Rear _____
Tire Payload Capacity _____
Warranted Tire Life _____

SUSPENSION

Type Front_____
Type Rear _____
Modifications Made During Conversion _____

STEERING

Type _____
Description _____
Manufacturer _____
Average Power Required (watts) _____

AIR CONDITIONING

Manufacturer _____
Model _____
Description _____
Compressor Type _____
Compressor Output (BTUs per hour)_____
Motor Type _____
Motor Electrical Rating _____
Average Power Required (watts) _____

HEATING SYSTEMS

Manufacturer_____
Model _____
Description _____
Type _____
Output (BTUs per hour) _____
Average Power Required (watts) _____

49 CFR 571.100 SERIES	METHOD OF ACHIEVING COMPLIANCE					
	OEM Certified	Vehicle Test	Analysis Only	Not Certified	Not Required	
101 - Controls and Displays						
102 - Transmission Shift Lever Sequence, Starter Interlock & Transmission Braking Effect						
103 - Windshield Defrosting and Defogging Systems						
104 - Windshield Wiping and Washing Systems						
105 - Hydraulic Brake Systems						
106 - Brake Hoses						
107 - Reflecting Surfaces						
108 - Lamps, Reflective devices, and Associated Equipment						
109 - New Pneumatic Tires						
110 - Tire Selection and Rims						
111 - Rearview Mirrors						
112 - Headlamp Concealment Devices						
113 - Hood Latch System						
114 - Theft Protection						
115 - Vehicle Identification Number - Basic Requirements						
116 - Motor Vehicle Brake Fluids						
117 - Retreaded Pneumatic Tires						
118 - Power Operated Window, Partition, and Roof Panel Systems						
119 - New Pneumatic Tires for Vehicles Other Than Passenger Cars						
120 - Tire Selection and Rims for Motor Vehicles Other Than Passenger Cars						
121 - Air Brake Systems						
124 - Accelerator Control Systems						
125 - Warning Devices						
126 - Truck-Camper Loading						
129 - New Non-Pneumatic Tires for Passenger Cars						

	METHOD OF ACHIEVING COMPLIANCE					
49 CFR 571.200 SERIES	**OEM Certified**	**Vehicle Test**	**Analysis Only**	**Not Certified**	**Not Required**	
201 - Occupant Protection in Interior Impact						
202 - Head Restraints						
203 - Impact Protection for the Driver from the Steering Control System						
204 - Steering Control Rearward Displacement						
205 - Glazing Materials						
206 - Door Locks and Door Retention Components						
207 - Seating Systems						
208 - Occupant Crash Protection						
209 - Seat Belt Assemblies						
210 - Seat Belt Assembly Anchorages						
211 - Wheel Nuts, Wheel Discs and Hub Caps						
212 - Windshield Mounting						
213 - Child Restraint Systems						
214 - Side Impact Protection						
216 - Roof Crush Resistance - Passenger Cars						
219 - Windshield Zone Intrusion						
49 CFR 571.300 SERIES						
301 - Fuel System Integrity						
302 - Flammability of Interior Materials						
49 CFR 581 SECTION AND TITLE						
Bumper Standard Requirements - All Sections						