MINIMUM UEV REQUIREMENTS

The UEV America Program is sponsored by the U.S. Department of Energy Office of Transportation Technology to provide for an independent assessment of urban electric vehicles (UEV), designed specifically for use in an urban (surface street) environment with speeds no greater than 45 mph. Vehicles tested under this program are evaluated against specific qualitative and quantitative metrics. The results provide potential users a method for comparing various UEVs against consistent standards and against each other, comparisons that might not otherwise be possible. The U.S. Department of Energy recognizes the UEV America program as requisite for funding of programs involving UEVs.

For a vehicle to be considered qualified for testing under the UEV America Program, it must comply with 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 that do not or cannot comply with all of the “Shall” requirements will be considered Prototypes, and will not be considered as having successfully completed the Program. The following requirements have been extracted from the body of the Vehicle Specification for convenience and clarity. In these requirements and in the Vehicle Specification, the term “Supplier” refers to the vehicle manufacturer. All of the following requirements must be met by any vehicle before it can receive consideration under the UEV America Program.

(1) 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. If the vehicle is a converted vehicle, both the OEM, and Converter Manufacturer Certification labels, shall be visible per the requirements of 49 CFR 567. Suppliers shall provide a completed copy of Appendix A and Appendix B, providing vehicle specifications 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.

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

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

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

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

(6) For conversions, OEM GVWR shall not be increased. For conversion vehicles, Suppliers shall specify the OEMs gross vehicle weight rating (GVWR).
(7) 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.

(8) Speedometers shall be provided and shall have an accuracy of at least ± 5% at 45 mph. Odometers shall be provided as standard equipment or as an option and shall have an accuracy of at least ± 5%.

(9) Tires shall be subject to the following requirements:
   • Tires provided with the vehicle shall be the standard tire for the vehicle being proposed.
   • Tires shall correspond to the requirements of the placard installed in accordance with 49 CFR 571.109 and 110, or 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.
   • Tires provided as original equipment shall not have warranty restrictions in excess of those of the tire’s manufacturer, unless the vehicle Supplier 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.

(10) Seating capacity shall be a minimum of 1 driver. 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.

(11) For conversion vehicles, the OEM passenger space shall not be intruded upon by the battery, battery box or other conversion materials. All vehicles shall comply with the requirements of 49 CFR 571.305

(12) The vehicle speed shall be limited below maximum speed for reverse travel.

(13) Vehilces 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.
(14) The controller/inverter shall control the minimum traction battery discharge voltage to prevent degradation of battery life and abrupt loss of controller/inverter function, and should limit the maximum regeneration voltage to prevent external gasing of the batteries.

(15) If different, customer available and battery available DOD ratings shall both be provided.

(16) Batteries shall comply with the requirements of SAE J1718 APR97. 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). Vented batteries shall not be used.

(17) 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. The test vehicles shall also comply with the requirement of proposed 49 CFR 571.305. Suppliers shall provide verification of conformance to these requirements.

(18) 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.

(19) Suppliers shall verify that the method(s) of charging the propulsion batteries and the charging algorithm(s) do not impact the battery supplier's warranty available to the end-user.

(20) Supplier's shall provide a detailed description of the BMS operation. The description of the driver interface shall be consistent with that provided in the owner’s manual.

(21) 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. Additionally, cable and wire marking shall consist of orange wire and/or orange sleeving as identified in SAE-J1127 MAR88.
(22) 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. Furthermore, for impact conditions, the vehicles shall also comply with the requirement of proposed 49 CFR 571.305. Suppliers shall provide verification of conformance to these requirements.

(23) 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 shall be affixed to the inside of the vehicle such that it is visible to individuals located outside the vehicle. It (the disconnect) shall include the following capabilities:

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

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).

(24) 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 “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.

(25) The vehicle shall include a state of charge indicator for the main propulsion batteries. Indications should be accurate to within 5% of full scale throughout its useable range.
(26) Vehicles shall be supplied 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 twelve (12) hours at temperatures noted in Section 5.5.

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.

(27) Chargers shall have the capability of accepting input voltages of 120 or 208/240V single phase 60 Hertz alternating current service, with a tolerance of 10% of rated voltage. On-board personnel protection systems, which may include ground fault circuit interrupters (GFCI), shall be in accordance with the provisions of UL Standard 2202, June 1999.

(28) Chargers shall have a true power factor of .95 or greater and a harmonic distortion of the current of less than 20%, when operating at full rated load.

(29) Regardless of the charger type used, the charger shall conform to the requirements of UL Standard 2202, June 1999.

(30) The installation of options shall not relieve Suppliers of meeting other “shall” requirements.

(31) 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.

(32) If a 120V charger is supplied, this charger shall comply with the requirements of Section 7.2 for isolation and Section 8.2 for personnel protection.

(33) Vehicles shall be accompanied by non-proprietary manuals for parts, service, operation and maintenance, interconnection wiring diagrams and schematics, (with pricing for optional manuals).

The following sections constitute the Technical Requirements of the Vehicle 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 urban electric vehicles, as well as identifying design and performance objectives.

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. 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 Electric Transportation Applications or the U.S. Government as having, by this specification and its requirements, established minimally sufficient safety standards. This written statement shall be provided with the Supplier’s submittal.
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. If the vehicle is a converted vehicle, both the OEM, and Converter Manufacturer Certification labels, shall be visible per the requirements of 49 CFR 567. Suppliers shall provide a completed copy of Appendix A and Appendix B, providing vehicle specifications 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 certified as other than ZEV (e.g., ULEV), 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.

2.2 CURB WEIGHT AND GROSS VEHICLE WEIGHT RATING (GVWR)
For conversions, OEM GVWR shall not be increased. Suppliers should provide the curb weight, rated payload and GVWR 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 shall be provided and shall have an accuracy of at least $\pm 5\%$ at 45 mph. Odometers shall be provided as standard equipment or as an option and shall have an accuracy of at least $\pm 5\%$.

2.5 BRAKING AND STEERING PERFORMANCE
For conversions, 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 for the vehicle being proposed.
- Tires shall correspond to the requirements of the placard installed in accordance with 49 CFR 571.109 and 110, or 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.
2.6 TIRES (continued)

- Tires provided as original equipment shall not have warranty restrictions in excess of those of the tire’s manufacturer, unless the vehicle Supplier 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 requirement:
- 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 to GVWR.
3.0 VEHICLE CHARACTERISTICS

3.1 SEATING CAPACITY

Seating capacity shall be a minimum of 1 driver. 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. All vehicles shall comply with the requirements of 49 CFR 571.305.

3.3 ELECTROMAGNETIC SUSCEPTIBILITY

Vehicles should comply with the relevant sections of SAE J551 JUN94, “Test Limits and Methods of Measurement of Radio Disturbance Characteristics of Vehicles and Devices, Broadband and Narrowband, 150kHz to 1000MHz” 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.
4.0 DRIVE SYSTEM

4.1 TRANSMISSION
The vehicle should utilize a single speed or multi-speed automatic transmission and a parking mechanism. The vehicle speed shall be limited below maximum speed for reverse travel.

4.2 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.

4.3 REGENERATIVE BRAKING SYSTEM
Regenerative braking should not adversely impact the vehicle’s braking ability on varying road surfaces to such extent that the vehicle's certification to 49 CFR 571.105 or 49 CFR 571.135 (as applicable) is impacted. Suppliers should describe the operation of the regenerative braking system and it’s interface with braking and anti-lock brake systems.

4.4 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.

4.5 BATTERY VOLTAGE LIMITS
The controller/inverter shall control the minimum traction battery discharge voltage to prevent degradation of battery life and abrupt loss of controller/inverter function, 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.

4.6 DRIVE TRAIN
Drive train components should not produce or develop unusual vibrations over the entire design speed range of the vehicle.
5.0 VEHICLE PERFORMANCE

5.1 ACCELERATION
The vehicle should have a 0-30 mph acceleration time of 8.5 seconds, or less, when operated with a payload of 332 pounds and starting with batteries at a 50% State of Charge.

5.2 MINIMUM TOP SPEED
The vehicle should have a minimum top speed of 45 MPH within 1 mile, when operated with a payload of 332 pounds and starting with batteries at a 50% state of charge.

5.3 LOW SPEED GRADEABILITY
Vehicles should be capable of starting and ascending a 25% grade when operated with a payload of 332 pounds and starting with batteries at 50% state of charge.

5.4 RANGE BETWEEN CHARGES
Vehicles should have a range of at least 30 miles when operated with a payload of 332 pounds and subjected to the UDS Drive Cycle (established in SAE J1634 MAY93) at an ambient temperature of 77 ±9°F.

5.5 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 -20F to +120F, paved surface temperatures greater than 150F, and occupant compartment temperatures exceeding 170F.

5.6 WATER DURABILITY
Vehicles should be able to endure 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, June 1999.
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 battery 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. 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). Vented batteries shall not be used.

6.3 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.

6.4 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. The test vehicles shall also comply with the requirement of proposed 49 CFR 571.305. Suppliers shall provide verification of conformance to these requirements.
6.5 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.

6.6 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.

6.7 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.

6.8 BATTERY CHARGING ALGORITHM

Suppliers shall verify that the method(s) of charging the propulsion batteries and the charging algorithm(s) do not impact the battery supplier's warranty available to the end-user. The charging algorithm(s) should have been reviewed and approved by the battery manufacturer.

6.9 BATTERY MANAGEMENT SYSTEM

The vehicle should 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 should automatically limit battery discharge below a pre-determined minimum level. Supplier's shall provide a detailed description of the BMS operation. The description of the driver interface 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.
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. Suppliers should provide details on grounding and isolation methods. Furthermore, for impact conditions, the vehicles shall also comply with the requirement of proposed 49 CFR 571.305. Suppliers shall provide verification of conformance to these requirements.

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 shall be affixed to the inside of the vehicle such that it is visible to individuals located outside the vehicle. The requirements for visibility and labeling should be the same as those denoted in 49 CFR 565 for VIN labels. This disconnect should be operable from the driver’s seated position. It shall include the following capabilities:

- Have 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). The manual service 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 “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.

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 as described in SAE J590b.

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 within 5% of full scale throughout its useable range.

7.7 CONNECTORS

High voltage plugs, receptacles and couplers should meet the proposed requirements of UL2251-1.

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 Charger Operations

Vehicles shall be supplied 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 twelve (12) hours at temperatures noted in Section 5.5. 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.

8.2 Charging Input Power

Chargers shall have the capability of accepting input voltages of 120 or 208/240V single phase 60 Hertz alternating current service, with a tolerance of 10% of rated voltage. On-board personnel protection systems, which may include ground fault circuit interrupters (GFCI), shall be in accordance with the provisions of UL Standard 2202, June 1999.

8.3 Power Quality

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

8.4 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 Standard 2202, June 1999.
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. 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 chlorofluorocarbons (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 30 miles when subjected to the UDS Drive Cycle contained in SAE J1634 MAY93 with the vehicle operated in an outdoor ambient temperature that does not exceed 25F after the vehicle has been parked for 48 hours at ambient 10F 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 65F at an ambient temperature of 10F. 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 DIAGNOSTIC SYSTEM
Suppliers should describe a diagnostic system for the controller/inverter.

9.7 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 8.2 for personnel protection. The charger should recharge the vehicle as quickly as possible from a 15A single phase GFCI breaker.

9.8 AMMETER
Suppliers should offer an ammeter or similar indicator capable of providing an indication of the charging and discharging currents of the propulsion battery.

9.9 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
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.
APPENDIX A

PERFORMANCE

Time required to accelerate from 0-30 on a level grade ___________________________
Maximum speed attainable on a level grade ____________________________________
Maximum grade attainable from a standing start ________________________________
Range at a constant speed of 45 mph _____________________________
Range over the SAE J1634 UDS drive cycle ___________________________________

BATTERY CHARACTERISTICS (referenced to 25°C)

Manufacturer ____________________________________________________________
Model __________________________________________________________________
Type ___________________________________________________________________
Description _____________________________________________________________
Vehicle requires ventilation per NEC 625 and UL-2202  [ ] Yes  [ ] No
Batteries labeled by UL recognized authority as not requiring ventilation  [ ] Yes  [ ] No
Number of batteries in the pack _____________________________________________
Arrangement (series or parallel) _____________________________________________
Battery module voltage ____________________________________________________
Battery pack voltage ______________________________________________________
Battery module weight _____________________________ kg
Battery pack weight (including removable pack structures) ___________________ kg
Maximum normal gassing rate (cc/min) ____________ volume (cc) ________________
Maximum abnormal gassing rate (cc/min) ____________ volume (cc) ________________
Battery capacity to 100% Manufacturer’s DOD, 1 hour rating (Ah) ________________
Battery capacity to 100% Manufacturer’s DOD, 2 hour rating (Ah) ________________
Battery capacity to 100% Manufacturer’s DOD, 3 hour rating (Ah) ________________
Battery energy to 100% Manufacturer’s DOD, 1 hour rating (Wh) ________________
Battery energy to 100% Manufacturer’s DOD, 2 hour rating (Wh) ________________
Battery energy to 100% Manufacturer’s DOD, 3 hour rating (Wh) ________________
Probable life of an average battery (number of cycles) to a Manufacturer’s DOD of:
  50% _______________________________________________________________________
  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:
  50% _______________________________________________________________________
  80% _______________________________________________________________________
Maximum recommended Customer DOD _____________ % ___________________ Ah
Battery specific power at 0% DOD _____________________________________________ Wh/kg
## APPENDIX A (continued)

### CHARGER CHARACTERISTICS

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<thead>
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<th>Manufacturer</th>
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<tr>
<td>Model</td>
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<tr>
<td>UL file number</td>
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<td>Description</td>
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<tr>
<td>Location</td>
<td>________________________________</td>
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<tr>
<td>Charger efficiency at rated load (%)</td>
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<tr>
<td>Charger input voltages (VAC)</td>
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<tr>
<td>Charger input power factor at rated load (%)</td>
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<tr>
<td>Charger input total harmonic distortion at rated load (%)</td>
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<tr>
<td>Maximum charger current output at rated power (A)</td>
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### MOTOR CHARACTERISTICS

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<td>Model</td>
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<tr>
<td>Description</td>
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<tr>
<td>Type (AC, DC, Brushless, etc.)</td>
<td>________________________________</td>
</tr>
<tr>
<td>Rated efficiency % @ kW</td>
<td>________________________________</td>
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<tr>
<td>Operating range (RPM)</td>
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<tr>
<td>Maximum intermittent power kW for minutes</td>
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<tr>
<td>Maximum continuous power</td>
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<tr>
<td>Cooling medium and method</td>
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### CONTROLLER CHARACTERISTICS

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<tr>
<td>Input Voltage Range</td>
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<tr>
<td>Maximum Output (A)</td>
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<tr>
<td>Type of Power Electronics (IGBT, mosfet, etc.)</td>
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<tr>
<td>Rated Efficiency % @ A</td>
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<tr>
<td>Method used to limit maximum battery discharge</td>
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</table>
APPENDIX A (continued)

TRANSMISSION CHARACTERISTICS

Manufacturer ____________________________________________________________
Type ___________________________________________________________________
Model __________________________________________________________________
Description _____________________________________________________________
Gear Ratio(s) ____________________________________________________________

CHASSIS CHARACTERISTICS - Pre-Conversion

Make, Year and Model ____________________________________________________
Gross vehicle weight rating (kg) ____________________________________________
Gross axle weight rating (kg) ___________________ front ___________________ rear
Curb weight (kg) _________________________________________________________
Weight distribution % front % rear % rear
Payload capacity (kg) _____________________________________________________
Ground clearance from lowest point on chassis at GVWR (cm) __________________
Drive wheels (F/R) _______________________________________________________
Number of seating positions ______________________________________________
Passenger area dimension ________________________________________________
Passenger area volume ___________________________________________________
Cargo area dimensions ___________________________________________________
Cargo area volume _______________________________________________________
Wheelbase __________________________________________________________________inches
Track ________________________inches front ________________________inches rear
Body height __________________________________________________________________inches
Body width __________________________________________________________________inches

CHASSIS CHARACTERISTICS - Post-Conversion

Make, Year and Model ____________________________________________________
Gross vehicle weight rating (kg) ____________________________________________
Gross axle weight rating (kg) ___________________ front ___________________ rear
Curb weight (kg) _________________________________________________________
Weight distribution % front % rear % rear
Payload capacity (kg) _____________________________________________________
Ground clearance from lowest point on chassis at GVWR (cm) __________________
Drive wheels (F/R) _______________________________________________________
Number of seating positions ______________________________________________
Passenger area dimension ________________________________________________
Passenger area volume ___________________________________________________

APPENDIX A (continued)

CHASSIS CHARACTERISTICS - Post-Conversion (continued)
Cargo area dimensions ____________________________________________________
Cargo area volume _______________________________________________________
Wheelbase ________________________________________________________ inches
Track ________________________________________________________ inches front inches rear
Body height _______________________________________________________ inches
Body width ________________________________________________________ inches

BRAKING
Type front ______________________________________________________________
Type rear _______________________________________________________________
Power source, if used ______________________________________________________
Average power, if used (W) ________________________________________________
Maximum regenerative braking (kW) _________________________________________

TIRES
Manufacturer ____________________________________________________________
Model __________________________________________________________________
Description _____________________________________________________________
Size and profile __________________________________________________________
Rolling resistance rating __________________________________________________
Pressure (psi) front rear
Weight capacity (lbs) ______________________________________________________
Are these tires standard equipment ☐ or optional equipment ☐
Describe warranty term and coverage _________________________________________

SUSPENSION
Type front ______________________________________________________________
Type rear _______________________________________________________________
Modifications made during conversion, if any _________________________________

STEERING
Type ________________________________________________________________
Description _____________________________________________________________
Manufacturer ____________________________________________________________
Power source, if used _____________________________________________________
Average Power Required (W) _______________________________________________
APPENDIX A (continued)

AIR CONDITIONING

| Manufacturer | | |
|--------------|---|
| Model | | |
| Description | | |
| Compressor Type | | |
| Maximum cooling output (BTU/hr) | | |
| Motor type | | |
| Maximum power required (kW) | | |

HEATING SYSTEMS

| Manufacturer | | |
|--------------|---|
| Model | | |
| Description | | |
| Type | | |
| Maximum heating output (BTU/hr) | | |
| Maximum power required (kW) | | |
| Certifiable under CARB ZEV requirements | Yes | No |
| EPA ZEV Certificate of Conformity | Yes | No |
REQUIRED SUBMITTALS

The following submittals are required from the Supplier prior to vehicle delivery.

- 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 Electric Transportation Applications or the U.S. Government as having, by this specification and its requirements, established minimally sufficient safety standards.

- 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.

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

- 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.

- Suppliers should specify interior passenger and cargo dimensions and volumes.

- Suppliers should describe the operation of the regenerative braking system and it’s interface with braking and anti-lock brake systems.

- Suppliers should specify the voltage limits which limit the maximum battery discharge and describe how these limits are implemented.

- 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 battery 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.

- 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 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.

- Suppliers shall provide verification of conformance to the requirements of Section 6.4 of UEV America Vehicle Technical Specification Revision 2, January 1, 2003.
APPENDIX A (continued)

• 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.

• 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.

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

• Suppliers shall verify that the method(s) of charging the propulsion batteries and the charging algorithm(s) do not impact the battery supplier's warranty available to the end-user. The charging algorithm(s) should have been reviewed and approved by the battery manufacturer.

• Supplier's shall provide a description of the BMS operation. This description shall be consistent with that provided in the owner’s manual.

• Suppliers should provide details on grounding and isolation methods. Suppliers shall provide verification of conformance to the requirements of Section 7.2 of UEV America Vehicle Technical Specification Revision 2, January 1, 2003.

• The Supplier shall describe the automatic disconnect provided for the main propulsion batteries.

• Suppliers should describe the type, size and location of the point of the vehicle charging port.

• Suppliers should describe the following options (if available);
  • Air conditioning system
  • Occupant compartment pre-heating and pre-cooling system
  • Range extension options
  • Cold weather range extension
  • Passenger compartment heater
  • Controller/inverter diagnostic system
  • 120V charger
  • Ammeter
  • Amp-hour indicator

APPENDIX A (continued)
• Vehicles shall be accompanied by non-proprietary manuals for parts, service, operation and maintenance, interconnection wiring diagrams and schematics, (with pricing for optional manuals).
## APPENDIX B - FMVSS Certification Methodology

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<td>110 - Tire Selection and Rims</td>
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<td>111 - Rearview Mirrors</td>
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### 49 CFR 581

- Bumper Standard Requirements - All Sections

### 49 CFR 565

-
Vehicle Identification Number Requirements