Addendum # 1

BUS PROCUREMENT PROJECT
RFP # 269-2020-883

To: All Prospective Proposers

Date: 5/27/2020

Subject: Addendum 1 – RFP # 269-2020-883 – Bus Procurement Project

Please review the updated dates and Technical Specifications. The 45' foot buses have been replaced with a 60' articulated bus. Specifications for the 60’ articulated bus have been added.

- Pre-Proposal Meeting/teleconference: Friday, June 5, 2020 at 3:00 p.m.
- Responses to Proposer’s communications and/or Agency addenda: Friday, June 12, 2020
- Proposer communications and requests (Question Deadline): Friday, June 19, 2020 at 5:00 p.m.
- Proposal Due Date: Friday, July 31, 2020 at 5:00 p.m.

In the event additional changes or clarifications to this RFP are warranted, all Companies are responsible for monitoring the City’s Contract Opportunities site or www.ips.state.nc.us or for additional addenda.

We appreciate your interest in doing business with the City and look forward to receiving a Proposal from your company.

Sincerely,

John Larson
Sr. Procurement Officer

SECTION 6: TECHNICAL SPECIFICATIONS

GENERAL

Scope
Technical specifications define requirements for heavy-duty transit buses, which, by the selection of specifically identified alternative configurations, may be used for both suburban express service and general service on urban arterial streets. Buses shall have a minimum expected life of twelve (12) years or 500,000 miles, whichever comes first, and are intended for the widest possible spectrum of passengers, including children, adults, the elderly and people with disabilities.
It is the intent of this specification to describe the design requirements for buses rugged enough to withstand rigorous intensive daily transit service operations and provide maximum reliability and availability, with a minimum of maintenance and repair time. The bus shall exhibit maximum passenger appeal in appearance, comfort and safety, combined with excellence in reliability, operating characteristics, efficiency, and economy of operation.

The bus shall be fully compliant with the applicable requirements of the Americans with Disabilities Act (ADA) and any revisions published by the Architectural and Transportation Barriers Compliance Board or The Federal Transit Administration for fixed route operations. Where these specifications exceed the requirements of ADA, the specification requirement shall apply.

Included in this specification is the description of required equipment for use in four different vehicle designs: 30-foot and 40-foot low-floor urban buses, 40-foot suburban buses, 60-foot articulated buses.

Definitions

Alternative. An alternative specification condition to the default bus configuration. The Agency may define alternatives to the default configuration to satisfy local operating requirements. Alternatives for the default configuration will be clearly identified.

Ambient Temperature. The temperature of the surrounding air. For testing purposes, ambient temperature must be between 16 °C (50 °F) and 38 °C (100 °F).

Analog Signals. A continuously variable signal that is solely dependent upon magnitude to express information content.

NOTE: Analog signals are used to represent the state of variable devices such as rheostats, potentiometers, temperature probes, etc.

Audible Discrete Frequency: An audible discrete frequency is determined to exist if the sound power level in any 1/3-octave band exceeds the average of the sound power levels of the two adjacent 1/3-octave bands by 5 decibels (dB) or more.

Battery Compartment. Low-voltage energy storage, i.e. 12/24 VDC batteries.

Battery Management System (BMS). Monitors energy, as well as temperature, cell or module voltages, and total pack voltage. The BMS adjusts the control strategy algorithms to maintain the batteries at uniform state of charge and optimal temperatures.

Braking Resistor. Device that converts electrical energy into heat, typically used as a retarder to supplement or replace the regenerative braking.

Burst Pressure. The highest pressure reached in a container during a burst test.

Capacity (fuel container). The water volume of a container in gallons (liters).

Cells. Individual components (i.e., battery or capacitor cells).


Container Appurtenances. Devices connected to container openings for safety, control or operating purposes.
**Container Valve.** A valve connected directly to a container outlet.

**Curb Weight.** Weight of vehicle, including maximum fuel, oil and coolant; and all equipment required for operation and required by this Specification, but without passengers or driver.

**dBA.** Decibels with reference to 0.0002 microbar as measured on the “A” scale.

**DC to DC Converter.** A module which converts a source of direct current (DC) from one voltage level to another.

**Default Configuration Bus.** The bus described if no alternatives are selected. Signing, colors, the destination sign reading list and other information must be provided by the Agency.

**Defueling.** The process of removing fuel from a tank.

**Destroyed.** Physically made permanently unusable.

**Discrete Signal.** A signal that can take only pre-defined values, usually of a binary 0 or 1 nature where 0 is battery ground potential and 1 is a defined battery positive potential.

**DPF.** Diesel particulate filter.

**Driver's Eye Range.** The 95th-percentile ellipse defined in SAE Recommended Practice J941, except that the height of the ellipse shall be determined from the seat at its reference height.

**Energy Density.** The relationship between the weight of an energy storage device and its power output in units of watt-hours per kilogram (Wh/kg).

**Energy Storage System (ESS).** A component or system of components that stores energy and for which its supply of energy is rechargeable by a PPU and/or an off-vehicle energy source.

**Fuel Line.** The pipe, tubing or hose on a vehicle, including all related fittings, through which diesel fuel passes.

**Fusible Material.** A metal, alloy or other material capable of being melted by heat.

**Fire Resistant.** Materials that have a flame spread index less than 150 as measured in a radiant panel flame test per ASTM-E 162-90.

**Fireproof.** Materials that will not burn or melt at temperatures less than 2000 °F.

**Free Floor Space:** Floor area available to standees, excluding the area under seats, area occupied by feet of seated passengers, the vestibule area forward of the standee line, and any floor space indicated by manufacturer as non-standee areas such as, the floor space “swept” by passenger doors during operation. Floor area of 1.5 sq ft shall be allocated for the feet of each seated passenger that protrudes into the standee area.

**GAWR (Gross Axle Weight Rated).** The maximum total weight as determined by the axle manufacturer, at which the axle can be safely and reliably operated for its intended purpose.

**Gross Load.** 150 lbs for every designed passenger seating position, for the driver, and for each 1.5 square feet of free floor space.
GVW (Gross Vehicle Weight). Curb weight plus gross load.

GVWR (Gross Vehicle Weight Rated): The maximum total weight as determined by the vehicle manufacturer, at which the vehicle can be safely and reliably operated for its intended purpose.

High Voltage (HV). Greater than 50 volts (AC and DC).

Hose: Flexible line.

Hybrid. A vehicle that uses two or more distinct power sources to propel the vehicle.

Hybrid System Controller (HSC). Regulates energy flow throughout hybrid system components in order to provide motive performance and accessory loads, as applicable, while maintaining critical system parameters (voltages, currents, temperatures, etc.) within specified operating ranges.

Hybrid Drive System (HDS). The mechanical and/or electromechanical components, including the PPU and energy storage system, which comprise the traction drive portion of the hybrid propulsion system.

Inverter. A module that converts DC to and from AC.

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization, which is acceptable to the authority having jurisdiction and concerned with product evaluation, which maintains periodic inspection of production labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Leakage. Release of contents through a Defect or crack. See Rupture.

Line: All tubes, flexible and hard, that carry fluids.

Local Regulations. Regulations below the state level.

Low-Floor Bus. A bus that, between at least the front (entrance) and rear (exit) doors, has a floor sufficiently low and level so as to remove the need for steps in the aisle between the doors and in the vicinity of these doors.

Low Voltage (LV). 50 volts or less (AC and DC).

Maintenance Personnel Skill Levels: Defined below are maintenance personnel skill levels and straight wage rates used in Section III, Technical Specifications; Attachment 1, Quality Assurance Provisions, and Attachment 2, Warranty Provisions.

5M: Tradesperson, (e.g., Wireperson, Pipefitter)
4M: 1st Class Machinist
3M: 2nd Class Machinist
2M: Shifter, Bus Operator
1M: 3rd Class Machinist Fueler

Maximum Service Temperature. The maximum temperature to which a container/cylinder will be subjected in normal service.

Metallic Hose. A hose whose strength depends primarily on the strength of its metallic parts; it can have metallic liners or covers, or both.
Module. Assembly of individual components

Motor (Electric). A device that converts electrical energy into mechanical energy.

Motor (Traction). An electric motor used to power the driving wheels of the bus.

Operating Pressure. The varying pressure developed in a container during service.

Physical Layer. The first layer of the seven-layer International Standards Organization (ISO) Open Systems Interconnect (OSI) reference model. This provides the mechanical, electrical, functional and procedural characteristics required to gain access to the transmission medium (e.g., cable) and is responsible for transporting binary information between computerized systems.

Pipe: Nonflexible line.

Power. Work or energy divided by time

Power Density. Power divided by mass, volume or area.

Propulsion System. System that provides propulsion for the vehicle proportional to operator commands. Includes, as applicable, the HDS, energy storage system and the hybrid system controller.

Real-Time Clock (RTC). Computer clock that keeps track of the current time.

Regenerative Braking. Deceleration of the bus by switching motors to act as generators, which return vehicle kinetic energy to the energy storage system.

Rejectable Damage. In terms of NGV fuel containers/cylinders, this is damage as outlined in CGA C-6.4, “Methods for External Visual Inspection of Natural Gas Vehicle Fuel Containers and Their Installations,” and in agreement with the manufacturer’s recommendations.

Retarder. Device used to augment or replace some of the functions of primary friction based braking systems of the bus.

Rupture. Sudden and unstable damage propagation in the structural components of the container resulting in a loss of contents. See Leakage.

Seated Load. 150 lbs for every designed passenger seating position and for the driver.

SLW (Seated Load Weight). Curb weight plus seated load.

Serial Data Signals. A current loop based representation of ASCII or alphanumeric data used for transferring information between devices by transmitting a sequence of individual bits in a prearranged order of significance. An example is the communication that takes place between two or more electronic components with the ability to process and store information.

Solid State Alternator. A module that converts high-voltage DC to low-voltage DC (typically 12/24 volt systems).

Sources of Ignition. Devices or equipment that because of their modes of use or operation, are capable of providing sufficient thermal energy to ignite flammable compressed natural gas-air mixtures when introduced into such a mixture, or when such a mixture comes into contact with them.
Special Tools. Tools not normally stocked by the Agency.

Specification. A particular or detailed statement, account, or listing of the various elements, materials, dimensions, etc. involved in the manufacturing and construction of a product.

Standard. A firm guideline from a consensus group.

Standards. Standards referenced in “Part 5: Technical Specifications” are the latest revisions unless otherwise stated.

Standee Line. A line marked across the bus aisle to designate the forward area that passengers may not occupy when the bus is moving.

State of Charge (SOC). Quantity of electric energy remaining in the battery relative to the maximum rated Amp hour (Ah) capacity of the battery expressed in percent. This is a dynamic measurement used for the energy storage system. A full SOC indicates that the energy storage system cannot accept further charging from the engine driven generator or the regenerative braking system.

Stress Loops. The “pig-tails” commonly used to absorb flexing in piping.

Structure. The structure shall be defined as the basic body, including floor deck material and installation, load bearing external panels, structural components, axle mounting provisions and suspension beams and attachment points.

Wheelchair. A mobility aid belonging to any class of three- or four-wheeled devices, usable indoors, designed for and used by individuals with mobility impairments, whether operated manually or powered. A “common wheelchair” is such a device that does not exceed 30 in. in width and 48 in. in length measured 2 in. above the ground, and does not weigh more than 600 lbs when occupied.

Referenced Publications
The documents or portions thereof referenced within this specification shall be considered part of the requirements of the specification. The edition indicated for each referenced document is the current edition, as of the date of the APTA issuance of this specification.

Legal Requirements
The bus shall meet and the Contractor shall comply with all applicable Federal, State, and local regulations in effect for motorbuses at the date of manufacture. These include but may not be limited to FMVSS, ADA, EPA and all applicable FMCSR and NFPA regulations in effect at the time the NTP is issued. Local regulations are defined as those below the state level. In the event of any conflict between the requirements of this Specification and any applicable legal requirement, then the legal requirement shall prevail.

The Contractor shall submit FMVSS certificates of compliance or waiver from appropriate regulatory agency before delivery of the first bus. The Contractor shall deliver a copy of the PTI Test Report for the bus before delivery of the pilot bus. The Contractor must comply with all provisions of CFR 49, including Current FTA Buy America Pre Award and Post Delivery Audit requirements.

Notwithstanding, anything in the Contract to the contrary, it is understood and agreed to by the Contractor that the Charlotte Area Transit System, herein referred to as “CATS” or the “Agency”, provided the Technical Specification for the sole purpose of describing in general terms the performance required from each bus, each bus’s systems and the discrete subsystems that make up the bus. The specification provided by the Agency does
not in any way constitute a design of the bus or of such subsystems or discrete components. It is further understood that the Agency makes no representations regarding the Technical Specifications. It shall be incumbent on the Contractor to verify the accuracy of the Technical Specifications prior to the time of the proposal submission.

This Technical Specification is intended to leave the Contractor free to provide its own detailed design for the basic vehicle and the vehicle’s ancillary equipment. The Contractor shall assume complete and overall responsibility for the design and satisfactory operation of the vehicle and the vehicle’s subsystems or component parts. The Contractor’s responsibility includes, but is in no way limited to, ensuring that the design and manufacture of the vehicle and the vehicles component parts are appropriate, coordinated, and compatible and that they perform correctly throughout the life of the vehicle, whether together or individually.

The Contractor shall ensure that each manufacturer of major items of equipment (for example, engine, transmission, brakes, air conditioning, heating and cooling controls, doors and controls, seats, lighting) has a complete copy of the Technical Specifications. Sub-suppliers shall approve of and sign-off on the Contractor’s specific application of their components. Proof of sub-suppliers installation approval shall be provided to the Agency.

**Overall Requirements**

The Contractor shall ensure that the application and installation of major bus subcomponents and systems are compliant with all such subcomponent vendors’ requirements and recommendations. Contractor and Agency shall identify subcomponent vendors that shall submit installation/application approval documents with the completion of a pilot or lead bus. Components used in the vehicle shall be of heavy-duty design and proven in transit service.

**Weight**

It shall be a design goal to construct each bus as light in weight as possible without degradation of safety, appearance, comfort, traction or performance.

Buses at a capacity load shall not exceed the tire factor limits, brake test criteria or structural design criteria.

The Contractor shall weigh each completed bus at shipment using a certified scale that produces a printed record of the weight, measured in pounds, and shall furnish the weight ticket to the Agency. Weights of components added by the Contractor after shipment, but before acceptance of the bus, shall be recorded on the vehicle acceptance form and inserted in the respective Bus History Book.

**Capacity**

The vehicle shall be designed to carry the gross vehicle weight, which shall not exceed the bus GVWR.

**Service Life**

The minimum useful design life of the bus in transit service shall be at least twelve (12) years or 500,000 miles. It shall be capable of operating at least 40,000 miles per year, including the 12th year.

**Maintenance and Inspection**

Scheduled maintenance tasks shall be related and shall be, in accordance with the manufacturer’s recommended preventative maintenance schedule (along with routine daily service performed during the fueling operations).

Test ports, as required, shall be provided for commonly checked functions on the bus, such as air intake, exhaust, hydraulic, pneumatic, charge-air and engine cooling systems to include oil and transmission sampling ports.
The coach manufacturer shall give prime consideration to the routine problems of maintaining the vehicle. All coach components and systems, both mechanical and electrical, which will require periodic physical work or inspection processes shall be installed so that a minimum of time is consumed in gaining access to the critical repair areas. It shall not be necessary to disassemble portions of the coach structure and/or equipment such as seats and flooring under seats in order to gain access to these areas. Each coach shall be designed to facilitate the disassembly, reassembly, servicing or maintenance, using tools and equipment that are normally available as standard commercial items.

Requirements for the use of unique specialized tools will be minimized. The body and structure of the coach shall be designed for ease of maintenance and repair. Individual panels or other equipment which may be damaged in normal service shall be repairable or replaceable. Ease of repair shall be related to the vulnerability of the item to damage in service.

Contractor shall provide a list of all special tools to include any cradles and fixtures needed to remove components, as well as all required training aids and all special tooling for bus systems unique to each bidder and type of bus and pricing required for maintaining this equipment. Said list shall be submitted as a supplement to the Pricing Schedule. Tools such as compartment door keys, bellows gauges and other tools that are required for daily maintenance and inspections shall not be included in the special tool list and shall be furnished for each coach.

Scheduled maintenance or inspection tasks as specified by the Contractor shall require a skill level of 3M or less. Scheduled maintenance tasks shall be related and shall be grouped in maximum mileage intervals. Based upon the design operating profile, routine scheduled maintenance actions, such as filter replacement and adjustments, shall not be required at intervals of less than 6,000 miles, except for routine daily service performed during the fueling operations. Oil/filter change intervals may be extended, as indicated from a regular oil analysis program undertaken in cooperation with the engine manufacturer. Higher levels of scheduled maintenance tasks shall occur at even multiples of mileage for lower level tasks.

All systems or components serviced as part of periodic maintenance or whose failure may result in Class 1 or Class 2 failures shall be readily accessible for service and inspection. To the extent practical, removal or physical movement of components unrelated to the specific maintenance and/or repair tasks involved shall be unnecessary.

Relative accessibility of components, measured in time required to gain access, shall be inversely proportional to frequency of maintenance and repair of the components.

Interchangeability

Unless otherwise agreed, all units and components procured under this Contract, whether provided by Suppliers or manufactured by the Contractor, shall be duplicates in design, manufacture and installation to ensure interchangeability among buses in each order group in this procurement. This interchangeability shall extend to the individual components as well as to their locations in the buses. These components shall include, but are not limited to, passenger window hardware, interior trim, lamps, lamp lenses and seat assemblies. Components with non-identical functions shall not be, or appear to be, interchangeable.

Any one component or unit used in the construction of these buses shall be an exact duplicate in design, manufacture and assembly for each bus in each order group in this Contract. Contractor shall identify and secure approval for any changes in components or unit construction provided within a Contract.

In the event that the Contractor is unable to comply with the interchangeability requirement, the Contractor must notify the Agency and obtain the Agency’s prior written approval, including any changing in pricing.
Agency shall review proposed product changes on a case-by-case basis and shall have the right to require extended warranties to ensure that product changes perform as least as well as the originally supplied products.

**Training**

**Training and Technical Support**
- All Training, Training aids, and Training Modules shall be priced separately from the bus base price.

Bus related training for the Agency’s personnel shall consist of five phases:

a) Bus operation, which includes detecting and resolving in service problems and emergencies that result in minimal delays.

b) Maintenance of components or assemblies—which includes inspections, lubrication, adjustments, repairs, and replacements normally performed at the Maintenance Shop.

c) Overhaul or repair of components or assemblies normally performed at the Agency’s overhaul shops including:
   - Engine including DPF/hybrid
   - Transmission/hybrid
   - Starter
   - Alternator
   - Rear drive carrier
   - Hydraulic pumps
   - Water pumps
   - Steering boxes

   - Hybrid Drive and Hybrid Battery System

d) Familiarization with renewal parts.

e) Facility support and OEM Liaison.

The Agency shall be responsible for providing classroom facilities and space for training aids. The Agency shall approve in advance the course content for each training program. Six (6) months after the NTP, the Contractor shall furnish the Agency with an outline of the training program for evaluation. The outline shall include the number of classroom and field instruction hours that the Contractor recommends for each system on the bus; the qualifications of the instructors; a list of training aids to be used and furnished; and a brief description of the scope of instruction to be covered.

The Contractor and appropriate suppliers shall train the Agency personnel on actual equipment whenever possible. The Contractor or suppliers shall be responsible for replacing any consumables and re-establishing the condition of any parts damaged as a direct result of training activities.

As part of the maintenance-training program, one (1) complete set of all special tools and test equipment necessary to service and maintain each bus system shall be provided at the time of delivery of the first production bus. Special tools are defined as those not readily available from an industry standard tool supplier, such as Snap-On or Matco. Examples of standard tools are combination wrenches, screws drivers, hammers or tools would normally be found in a mechanic tool box. Examples of special tools are temperature adapter, tachometer readers, valve driver, pressure probe, etc.
Instructions and/or training on how to use these special tools and equipment shall be provided at the same time. At the completion of the training program the special tools, test equipment, and training aids shall be turned over to the Agency in proper working order. The contractor shall assume that the Agency has no special tools for bus maintenance.

**Operator Training**
Operator training shall be based on the Operating Manual. To ensure the safety of maintenance personnel, operating personnel, and passengers, the Contractor shall supply two (2) sets of USB Flash Drives two (2) months prior to the delivery of the first production bus. The drives shall cover the following topics:

a) Revenue service preparation  
b) Normal operating procedures  
c) Emergency operating procedures  
d) Moving a bus with a problem (fault).

One month after the delivery of the first production bus, the Contractor shall instruct two (2) groups of ten (10) representatives from the Operations Department during separate two (2) day training sessions. The training shall take place at the Maintenance Facility and, as required, on-board fully operational buses.

A one (1) day, follow-up session shall be held for up to twenty (20) trainees. The follow-up shall take place one (1) month after the first six (6) buses have been accepted for revenue service. The Agency will provide the agenda at least one (1) week prior to the training. Contractor to provide Training Video for Operators

**Maintenance Training**
The Contractor shall provide sufficient training for the Agency’s personnel to permit satisfactory servicing and maintenance of the buses at the Agency’s garages. The training shall include classroom and “hands-on” instruction. The “hands-on” instruction shall be given on an operational bus or on functioning mockup training aids and include an introduction to faults, troubleshooting and subsequent repair.

Classroom instruction shall include not only the anatomy and functionality of the parts, but also the essentials of routine care, including lubrication schedules, adjustments, limits, test frequency, inspection frequency, troubleshooting, removal and replacement. At the conclusion of the classroom instructions, the Contractor shall furnish to the Agency a complete set of lesson plans and training aids including, but not limited to, classroom notes, films, photographs, displays, slides, and tapes used in presenting the courses.

The Contractor shall assume that the Agency’s personnel have no knowledge of the features of the buses. The course of instruction should include systems integration familiarization and be given in two parts. The first part shall occur two months prior to the delivery of the first production bus and shall cover basic instruction, including fundamentals and general familiarization with the buses and bus components. The second part of the instruction shall begin approximately one month after the delivery of the first production bus. A final schedule for maintenance training shall be submitted to the Agency for approval six (6) months before scheduled delivery of the first production bus. Maintenance training shall include in-depth instruction covering as a minimum the maintenance diagnostic, trouble shooting, rebuild and repair activities normally performed at a garage on the following systems:

- Power module  
- Bus electrical system  
- Bus air system  
- Door Systems  
- Mobilty aid ramp  
- Smart Bus Systems
- Engine and DPF systems
- Transmission & Retarder
- Destination Signage
- Radio
- Multiplex System
- Towing and Recovering
- DEF / SCR System / Controls
- Fuel System
- Operator Controls
- Safety Procedures
- Fire Suppression System
- Fuel Alley Procedures
- Hybrid Drive Systems
- AVL/APC System

High voltage training
- Rear axle assembly, including suspension and brakes
- Front axle assembly, including suspension and brakes
- HVAC system, including auxiliary heater and any floor level heating units and any EPA certifications required for handling refrigerants

The Contractor shall furnish fifty (50) copies of training manuals for each subject. In lieu of special training manuals, the Contractor may utilize the Running Repair and Service Manual, the Schedule Repair and Overhaul Manual and/or applicable Vendor Manuals for instructional purposes. In the event the Contractor utilizes such manuals, they will be in addition to the quantity, if any, specified in Section SP 7.2 Documentation.

The times and duration of the instruction periods, and the quantity of personnel available to attend class, shall be at the discretion of the Agency. The Agency will attempt to make six (6) trainees available for eight (8) hours per normal working day. The following minimum quantities of personnel to be instructed are provided as a guideline:

a) Engineers and supervisory personnel - Thirty (30)
b) Garage personnel – Thirty (30)
c) Maintenance Training Instructors – Six (6)

All of the above personnel will be made available for training no later than twelve (12) months after delivery of the first bus. The length of the instruction for each individual shall not be less than 200 hours.

**Overhaul Shop Training**

One month after the delivery of the first production bus the Contractor shall provide a training program that will permit satisfactory overhaul and repair of equipment normally performed at the Agency’s overhaul shops. In addition to the equipment listed in Section 3.1.10.9.2, the Contractor shall also provide training on the following equipment:

a) Bus body panel including a section of vertical and horizontal support structure (to demonstrate proper method of repairing body damage)
b) Air compressor
c) Front side and rear destination sign with controller
d) One of each type of motor/blower
e) One of each type of electronic circuit boards on assemblies.

f) Air Ride Operator’s Seat

Equipment overhaul training shall consist of three parts. The first part shall last one month and will be attended by thirty management, engineering, and shop personnel. It shall begin at the end of the garage maintenance training. The second part shall be a one-week “refresher course” given six (6) months after completion of the first part. The refresher course shall be attended by thirty personnel, not necessarily the same individuals attending the initial training. The agenda shall be provided by the Agency at least one month prior to the beginning of the refresher course. The third part shall be the factory training of two, Maintenance Instructors for both Engine and Transmission overhaul. The Contractor shall provide engine overhaul and transmission overhaul training at the respective vendor facilities. This training shall allow the Agency’s Instructors to attain Factory Instructor Certification (FIC) in overhaul procedures, thus enabling the Agency’s Instructors to certify additional repair personnel. The Agency’s Instructors would be allowed to train and administer the relevant testing to allow membership and full benefits to certification programs offered by the vendor such as “Detroit Diesel Guild” Cummins Virtual College Program. The cost of factory training and certification of Six Agency Maintenance Instructors is borne by the Contractor. The Agency retains responsibility of its personnel undergoing its FIC training.

**Shop Training: Add into paragraph after f) New sentence:**
Contractor shall provide training which certifies each member of the Training Team / Selected Tech’s (12) total with OEM Hybrid Certifications training so that each man is certified for all Hybrid repairs to included high voltage, diagnostics, repairs, rebuilds, etc.

**Training Aids**
The full scope of training aids shall be negotiated prior to Contract execution. The following information is a general guideline of the Agency’s training aid expectations.

The Contractor shall supply full size mock-up and component assemblies including necessary supporting and display racks, for the Agency to use initially and on a continuous basis as training aids. The mock-ups, may be board mounted to conserve space and to enhance conception of the actual operation of the sub-systems. Configuration of the training aid is subject to the Agency’s approval. The following training aids shall be delivered prior to commencement of training programs:

a) Power Module—Completely dressed and mounted upon a stand for operation (not under load) of engine and transmission with full instrumentation. Capable of operation without any auxiliary power supply or interfaces other than ventilated exhaust pipe. The module will contain the complete exhaust system, including the diesel particulate filter.

b) Diesel Engine—Complete engine, stand mounted, suitable for repeated disassembly and reassembly

c) Electrical System—Complete, full size, operational, board mounted, including multiplex system and interfaces with all electrical equipment. Can be plugged into 120VAC power for operational demonstration.

d) Transmission and Retarder—complete with coolers and plumbing, mounted on a stand suitable for repeated disassembly and reassembly.

e) Compressed Air System—complete with all valves and typical piping, operational, board mounted. Operation can be emulated by plugging into shop compressed air supply for operational demonstration.

f) Front & Rear Axle Assys.—Individually mounted with suspensions, on a stand suitable for repeated disassembly and reassembly.
g) Front & Rear Brake Assys.—Individually mounted on a stand suitable for repeated disassembly and reassembly.

h) HVAC System—Complete top unit with motor driven compressor and water supply that is stand mounted so that the unit is operable. System can be plugged into 120VAC power for operational demonstration. Any floor/underseat heating units shall be provided with typical piping and controls, mounted independent of the top HVAC unit.

i) Door System—Complete door and operator assembly including sensitive edges and safety devices. Both front and rear door, if not identical, mounted on a stand that can be plugged into 120VAC power and shop compressed air supply.

j) Destination Signage System—Front, side and rear sign units mounted with controller and Contractor supplied interfaces to Smart Bus Systems. Can be plugged into 120VAC power supply for operational demonstration.

k) Fire Suppression System—Complete stand mounted system with devices to allow safe, small-scale, demonstration of all functions. Can be plugged into 120VAC power for operational demonstration.

l) Mobility Aid Ramp—Stand mounted that allows operation and repeated disassembly and reassembly. Can be plugged into 120VAC power for operational demonstration.

m) Anti-Lock Brake System—Module and valves mounted for demonstration of operation, testing and repair procedures. Can be plugged into 120VAC power for operational demonstration.

n) PA System — Complete and operational with all controls, inside and outside speaker, and Contractor supplied interfaces to Smart Bus Systems. Can be plugged into 120VAC power for operational demonstration.

p) Computers and current Software—Provide two (2) laptop computers or Dell tablets for each 10 buses purchased for the life of the contract and include all All required hardware, software and connecting cables for servicing of bus systems including engine, HVAC, Hybrid drive, transmission, multiplex, ABS, destination signs and Smart Bus systems. Can be plugged into 120VAC or 12 volt DC power for operational demonstration. Laptops provided should be most current production Dell tablet or Deviation. Minimum requirements listed below.
   - Solid state hard drive 1TB or at least 500GB
   - Multiple usb/usbc ports, and ethernet port
   - 16GB RAM
   - Toughbook tablet with docking station
   - i7 processor or better with windows 10 or above, 64 bit operating system

q) Smart Bus Systems — Vehicle logic systems and operator interface components to operate on 120VAC power supply in a desktop arrangement with simulated operational and failure modes.

r) Diesel Particulate Filter — A complete unit with supporting bracketry and related fasteners to access unit's modules (if applicable), stand mounted and suitable for repeated disassembly and reassembly.

s) Driver's Compartment Module – A complete driver's compartment mock-up that includes all switches and controls available to the driver. A fitting for the supply of shop compressed air shall be provided.
to allow proper operation of the seat and the correct feel to the brake pedal, parking brake control and emergency park brake release control. Supply of 110VAC electric power shall allow operation of all switch and control lights and illumination of the diagnostic indicators. The module shall be no larger than necessary to correctly located all driver controls and of sufficient strength for transport by fork lift truck.

The Contractor shall supply one set color-coded schematics of above systems and integrated block diagrams of major equipment.

**Operating Environment**

The bus shall be capable of being operated at the specified performance levels, and stored and maintained without impairment resulting from the natural or induced environmental conditions within which the Agency intends to operate the bus in revenue service.

The following climatic factors shall be used as design guidelines and shall be considered as operational requirements.

a) Temperature and Solar Load:
   - Ambient air temperature:
     - Minimum: -10°F
     - Maximum: 120°F
   - Humidity:
     - Minimum: 5 percent
     - Maximum: 100 percent

b) Precipitation:
   - Maximum rainfall rate: 4 inches per hour
   - Maximum snowfall rate: 5 inches per hour

c) Wind:
   - Maximum sustained speed: 40 mph
   - Maximum gust speed: 70 mph

d) Air contamination: The vehicle shall operate as specified under air contamination levels which occur in the normal environment that exists in the Agency’s service area.

e) Road contamination: The vehicle shall operate as specified under the dust, trash, and leaf accumulation conditions experienced in the Agency’s service area. Salt and other chemicals are applied to streets during adverse winter weather conditions.

The bus shall achieve normal operation in ambient temperature ranges of -10 °F to 120 °F, at relative humidity between 5 percent and 100 percent, and at altitudes up to 3000 feet above sea level. Degradation of performance due to atmospheric conditions shall be minimized at temperatures below -10 °F, above 120 °F or at altitudes above 3000 feet. Altitude requirements above 3000 feet will need separate discussions with the engine manufacturer to ensure that performance requirements are not compromised. Speed, gradability and acceleration performance requirements shall be met at, or corrected to, 77 °F, 29.31 in. Hg, dry air per SAE J1995. Performance degradation at conditions other than the test standard shall not exceed one percent for each 3°F and four percent for each 1,000 feet of altitude above the standard.
Actual localized temperatures and conditions within and under the bus body may be more severe than those listed. The Contractor shall be responsible for evaluating and advising the Agency if there are any special environmental factors to which its equipment may be sensitive, and that are not listed in this section.

**Noise**

**Interior Noise**
The combination of inner and outer panels and any material used between them shall provide sufficient sound insulation so that a sound source with a level of 80 dBA measured at the outside skin of the bus shall have a sound level of 65 dBA or less at any point inside the bus. These conditions shall prevail with all openings, including doors and windows, closed and with the engine and accessories switched off.

The bus-generated noise level experienced by a passenger at any seat location in the bus shall not exceed 80 dBA. The driver area shall not experience a noise level of more than 75 dBA under the following test conditions:

- The bus shall be empty except for test personnel, not to exceed four (4) persons, and the test equipment;
- All openings shall be closed and all accessories shall be operating during the test;
- The bus shall accelerate at full throttle from a standstill to 35 mph on level commercial asphalt or concrete pavement in an area free of large reflecting surfaces within 50 feet of the bus path.
- During the test, the ambient noise level in the test area shall be at least 10 dBA lower than the bus under test.

Instrumentation and other general requirements shall conform to SAE Standard J366. If the noise contains an audible discrete frequency, a penalty of 5 dBA shall be added to the sound level measured.

**Exterior Noise**

Airborne noise generated by the bus and measured from either side shall not exceed 80 dBA under full power acceleration when operated 0 to 35 mph at curb weight. The maximum noise level generated by the bus pulling away from a stop at full power shall not exceed 83 dBA. The bus-generated noise at curb idle shall not exceed 65 dBA. If the noise contains an audible discrete frequency, a penalty of 5 dBA shall be added to the sound level measured. All noise readings shall be taken 50 feet from, and perpendicular to, the centerline of the bus with all accessories operating. Instrumentation, test sites, and other general requirements shall be in accordance with SAE Standard J366. The pull away test shall begin with the front bumper even with the microphone. The curb idle test shall be conducted with the rear bumper even with the microphone. The Contractor shall comply with the exterior noise requirements defined in local laws and ordinances identified by the Agency and SAE J366.

**Fire Safety**

**Fire Protection**
The passenger and engine compartments shall be separated by bulkhead which shall, by incorporation of fireproof materials in their construction, be firewalls. The engine compartment shall include areas where the engine and exhaust systems are housed including the muffler, if mounted above the horizontal shelf. This firewall shall preclude or retard propagation of an engine compartment fire into the passenger compartment and shall be in accordance with the Recommended Fire Safety Practices defined in FTA Docket 90, dated October 20, 1993. Only necessary openings shall be allowed in the firewall, and these shall be fireproofed. Any passageways for the climate control system air shall be separated from the engine compartment by fireproof material. Piping through the bulkhead shall have copper, brass, or fireproof fittings sealed at the firewall with copper or steel piping on the engine side. Wiring may pass through the bulkhead only if connectors or other means are provided to prevent or
retard fire propagation through the firewall. The conduit and bulkhead connectors shall be sealed with fireproof material at the firewall. Engine access panels in the firewall shall be fabricated of fireproof material sealed with heat resistant gaskets and secured with fireproof fasteners. These panels, their fasteners, and the firewall shall be constructed and reinforced to minimize warping of the panels during a fire that will compromise the integrity of the firewall.

**Fire Detection and Suppression System**
The bus shall be equipped with an Amerex fire detection/suppression system or Deviation. A fire control panel with audio/visual warning shall be provided to the operator’s dash panel.

A fire sensing and suppression system shall be provided to monitor the engine compartment with no less than three (3) temperature sensors and sufficient monitoring of other areas where fire hazard exists. An optical infrared flame detector shall be provided to monitor the engines turbo charger and surrounding area. The system shall meet or exceed the environmental requirements of SAE J1211. Upon detection, the system will alert the operator with visual and audible signals and initiate automatic engine shutdown and trigger the discharge of the fire suppression agent. Approval of the fire detection layout shall be approved during the pre-production meeting.

Three detectors will be located in the engine compartment area and one in the auxiliary heater area if it is located in an enclosed in a compartment. Detection of a fire may be by means of infrared/heat or rate of rise/heat. Detectors must be capable of operating in a range of -400°F to 2500°F without false detection from any source of light or steam cleaning.

A control panel shall electrically supervise the automatic fire suppression system following the wiring circuits for Power Supply, Fire/Heat Detected and System Actuation. Indication of Normal, Fault and fire conditions shall be displayed on the control monitor. The system control panel will shut down the engine within ten (10) seconds of a fire being detected through the engine protection shut down and override system. Integration of the fire suppression system warning lights with the bus warning light system is preferred with design considerations given to the convenience of the operator.

A minimum twenty-five (25) pound capacity agent cylinder of the stored pressure type shall be furnished and be constructed of welded steel and must conform to DOT specification 4BW, and be rated for twelve (12) years minimum hydrostatic retest. The cylinder shall be outfitted with a gauge that can be easily viewed and a forged brass valve assembly.

A minimum of four Brass nozzles shall be located in the engine compartment and one in the auxiliary heater compartment, if required, fitted with dust caps that, upon actuation, are displaced to allow full flow of the fire suppression agent. Fire suppression agent shall be Type ABC dry chemical. Visual inspection of the agent cylinder gauge shall be provided through one of the bus engine compartment service doors.

The Contractor shall provide written certification from the fire suppression manufacture that all installation requirements have been met and sufficient testing was made on the first bus system to ensure reliable firefighting operation.

**Respect for the Environment**
In the design and manufacture of the bus, the Contractor shall make every effort to reduce the amount of potentially hazardous waste. Contractor should use non-asbestos brake blocks and gaskets. In accordance with Section 6002 of the Resource Conservation and Recovery Act, the Contractor shall use, whenever possible and allowed by the specifications, recycled materials in the manufacture of the bus.
DIMENSIONS

Physical Size

With exceptions such as exterior mirrors, marker and signal lights, bumpers, fender skirts, washers, wipers, ad frames, cameras, object detection systems, bicycle racks, feelers and rub rails, the bus shall have the following overall dimensions as shown in Figure 1 at static conditions and design height.

FIGURE 1
Transit Bus Exterior Dimensions

Bus Length

For ease of use, the following tolerances will be allowable for each given bus length. Bus length is determined as the measurement from bumper to bumper.

- **30-ft bus**: 29 ft, 11 in. to 34 ft, 11 in.
- **40-ft bus**: 40 ft to 44 ft, 11 in.
- **60 ft (articulated bus)**: 60 to 60 ft 10 in

Bus Width

102-in. Width Bus

Body width shall be 102 in. (+0, -1 in.).
Bus Height

Maximum Overall Height
maximum overall height shall be 145 in., including all rigid, roof-mounted items such as A/C, exhaust, fuel system and cover, etc.

Step Height

Boarding Step
At the front door, the step up from street level shall not exceed fifteen (15) inches with the bus at the design height, and the step up from street level at the rear door shall not exceed sixteen (16) inches. Multiple steps are allowed on commuter coaches.

Interior Step Structure
A maximum of two steps, with not more than 8.5-inch risers of uniform height, may be provided in the aisle rearward of the rear door post leading to a high-floor area in the rear of the bus.

Underbody Clearance
The bus shall maintain the minimum clearance dimensions as shown in Figure 2 and defined in SAE Standard J689, regardless of load up to the gross vehicle weight rating.

Ramp Clearances
The approach angle is the angle measured between a line tangent to the front tire static loaded radius arc and the initial point of structural interference forward of the front tire to the ground.

The departure angle is the angle measured between a line tangent to the rear tire static loaded radius arc and the initial point of structural interference rearward of the rear tire to the ground.

The breakover angle is the angle measured between two lines tangent to the front and rear tire static loaded radius and intersecting at a point on the underside of the vehicle that defines the largest ramp over which the vehicle can roll.

Ground
Ground shall be no in., (8 in. at except within and wheel area.

Axle zone clearance, which is the projected area between tires and wheels on the same axial centerline, shall be no less than 5.5 in.

Wheel area clearance shall be no less than 8 in. for parts fixed to the bus body and 6 in. for parts that move vertically with the axles.

<table>
<thead>
<tr>
<th>Angle</th>
<th>30 to 40 ft Bus</th>
<th>60 ft Bus</th>
<th>Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approach</td>
<td>9 deg (min.)</td>
<td>9 deg (min.)</td>
<td>clearance less than 10 jacking pad</td>
</tr>
<tr>
<td>Front breakover</td>
<td>9 deg (min.)</td>
<td>12 deg (min.)</td>
<td></td>
</tr>
<tr>
<td>Rear breakover (articulated only)</td>
<td>n/a</td>
<td>9 deg (min.)</td>
<td></td>
</tr>
<tr>
<td>Departure</td>
<td>9 deg (min.)</td>
<td>9 deg (min.)</td>
<td>the axle zone</td>
</tr>
</tbody>
</table>
**Floor Height**
Height of the step above the street shall be no more than 16 in. measured at the centerline of the front and rear doorway. The floor may be inclined along the longitudinal axis of the bus, and the incline shall not exceed 3.5 degrees off the horizontal except locally at the doors where 2 degree slope toward the door is allowed. All floor measurements shall be with the bus at the design running height and on a level surface and with the standard installed tires. A maximum of two steps is allowed to accommodate a raised aisle floor in the rear of the bus.

**Interior Headroom**
Headroom above the aisle and at the centerline of the aisle seats shall be no less than 78 in. in the forward half of the bus tapering to no less than 74 in. forward of the rear settee. At the centerline of the window seats, headroom shall be no lower than 62 in., except for parcel racks and reading lights, if specified. Headroom at the back of the rear bench seat may be reduced to a minimum of 56 in., but it shall increase to the ceiling height at the front of the seat cushion. In any area of the bus directly over the head of a seated passenger and positioned where a passenger entering or leaving the seat is prone to strike his or her head, padding shall be provided on the overhead paneling.

**Aisle Width**
The minimum clear aisle width between pairs of transverse seats with all attached hardware shall be at least 22 in.

The aisle width between the front wheelhouses shall be at least 35.5 in., and the entire area between the front wheelhouses shall be available for passengers and mobility aid devices.

**VEHICLE PERFORMANCE**

**Power Requirements**
The propulsion system shall be sized to provide sufficient power to enable the bus to meet the defined acceleration, top speed, and gradability requirements, and operate all propulsion-driven accessories using actual
road test results and computerized vehicle performance data. Engine, Diesel Particulate Filter and transmission shall be equipped with electronic controls. Sufficient excess power shall be available to operate all accessories. Power requirements shall be met using ULSD or approved propulsion system.

**Top Speed**
The bus shall be capable of achieving a top speed of 65 mph on a straight, level road at GVWR with all accessories operating. The bus shall be capable of safely maintaining the vehicle speed according to the recommendations by the tire manufacturer.

**NOTE:** Values are assumed to be sustained. Manufacturer shall supply Agency with data if there is a variance between peak performance and sustained vehicle performance.

**Gradability**
Gradability requirements shall be met on grades with a dry commercial asphalt or concrete pavement at GVWR with all accessories operating.

The propulsion system and drivetrain shall enable the bus to achieve and maintain a speed of 40 mph on a 2½ percent ascending grade and 15 mph on a 10 percent ascending grade continuous.

**NOTE:** Values are assumed to be sustained. Manufacturer shall supply Agency with data if there is a variance between peak performance and sustained vehicle performance.

**Acceleration**
The acceleration shall meet the requirements below and shall be sufficiently gradual and smooth to prevent throwing standing passengers off-balance. An average acceleration rate of at least 0.06g shall be achieved at GVWR between zero (0) and fifteen (15) mph. Acceleration measurement shall commence when the accelerator is depressed.

**TABLE 3**
Maximum Start Acceleration Times on a Level Surface¹

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>Maximum time (seconds), Diesel</th>
<th>Maximum time (seconds), Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>20</td>
<td>10.8</td>
<td>8.5</td>
</tr>
<tr>
<td>30</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>40</td>
<td>31</td>
<td>26</td>
</tr>
<tr>
<td>50</td>
<td>55</td>
<td>50</td>
</tr>
</tbody>
</table>

¹. Vehicle weight = GVWR

**Hybrid**
The propulsion and braking systems shall meet the performance requirements of the Duty Cycle.

Braking application and performance shall remain consistent regardless of hybrid system State of Charge (SOC) or other variances related to regenerative braking.

The system shall be programmable to allow optimization of acceleration and deceleration rate. Performance may be affected when reprogramming. The manufacturer shall supply the new performance data.
Operating Range
The operating range shall be designed to meet the operating profile as stated in the “Design Operating Profile” section.

Diesel, CNG, or EV, TBD by Agency before bid.
The operating range when run on the Altoona Test cycle shall be at least 400 mi (560 km) or 20 hrs with full fuel capacity.

(Reserved)

Hybrid
The operating range of the coach when run on the design operating profile “Design Operating Profile” shall be at least 500 mi on a full tank of fuel.

Fuel Economy (Design Operating Profile)

Design Operating Profile
The operating profile for design purposes shall consist of simulated transit-type service in the Charlotte Metropolitan area of operation. The duty cycle is described in the figure "Transit Bus Duty Cycle." The duty cycle consists of the following phases to be repeated in sequence:

- Central Business District (CBD) Phase of two (2) miles with seven (7) stops per mile and a top speed of twenty (20) mph, with an average dwell time of seven (7) seconds per stop,

- Arterial Route Phase of two (2) miles with two (2) stops per mile and a top speed of forty (40) mph, with an average dwell time of seven (7) seconds per stop, and a

- Commuter Phase of four (4) miles with one (1) stop and a maximum speed of fifty-five (55) mph with a stop dwell time of twenty (20) seconds, and an end of line turnaround of five (5) minutes.

Transit Bus Duty Cycle

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CBD</td>
<td>7</td>
<td>20</td>
<td>2</td>
<td>155</td>
<td>10</td>
<td>540</td>
<td>18.5</td>
<td>6.78</td>
<td>60</td>
<td>4.5</td>
<td>7</td>
<td>9-20</td>
<td>14</td>
</tr>
<tr>
<td>Idle</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5-0</td>
<td>-</td>
</tr>
<tr>
<td>Arterial</td>
<td>2</td>
<td>40</td>
<td>2</td>
<td>1035</td>
<td>29</td>
<td>1035</td>
<td>22.5</td>
<td>6.78</td>
<td>255</td>
<td>9</td>
<td>7</td>
<td>4-30</td>
<td>4</td>
</tr>
<tr>
<td>CBD</td>
<td>7</td>
<td>20</td>
<td>2</td>
<td>155</td>
<td>10</td>
<td>540</td>
<td>18.5</td>
<td>6.78</td>
<td>60</td>
<td>4.5</td>
<td>7</td>
<td>9-20</td>
<td>14</td>
</tr>
<tr>
<td>Arterial</td>
<td>2</td>
<td>40</td>
<td>2</td>
<td>1350</td>
<td>29</td>
<td>1350</td>
<td>22.5</td>
<td>6.78</td>
<td>255</td>
<td>9</td>
<td>7</td>
<td>4-30</td>
<td>4</td>
</tr>
<tr>
<td>CBD</td>
<td>7</td>
<td>20</td>
<td>2</td>
<td>155</td>
<td>10</td>
<td>540</td>
<td>18.5</td>
<td>6.78</td>
<td>60</td>
<td>4.5</td>
<td>7</td>
<td>9-20</td>
<td>14</td>
</tr>
<tr>
<td>Commuter</td>
<td>1 stop for phase</td>
<td>Max or 55</td>
<td>4</td>
<td>5500</td>
<td>90</td>
<td>2 miles + 4580 ft.</td>
<td>188</td>
<td>6.78</td>
<td>480</td>
<td>12</td>
<td>20</td>
<td>5-10</td>
<td>1</td>
</tr>
</tbody>
</table>

Total | 14 | | | | | | | | | | | 47-10 | 51 |
The bus shall be loaded to SLW and shall average approximately eighteen (18) mph while operating on this duty cycle. Operation shall continue regardless of the ambient temperature or weather conditions. The passenger doors shall be opened and closed at each stop, and the bus shall be knelt at each stop during the CBD phase. The braking profile shall be:

- 16 percent of the stops at 3 fpsps
- 50 percent of the stops at 6 fpsps
- 26 percent of the stops at 9 fpsps
- 8 percent of the stops at 12 fpsps

These percentages of stops shall be evenly distributed over the three (3) phases of the duty cycle. For scheduling purposes, the average deceleration rate is assumed.

**DIESEL FUEL ECONOMY**

The engine shall be tuned when delivered to provide optimized performance as specified above, including fuel economy. All related components and configuration that affect fuel economy, such as, fan control/operation, transmission, axle ratio, etc., shall be selected accordingly. The bus shall achieve an average fuel economy of 4.50 miles per gallon when run on the Transit Bus Duty Cycle loaded to SLW. Reference SAE J1376, Fuel Economy Measurement Test (Engineering Type) for Trucks and Buses.

**Hybrid**

Energy storage system state of charge correction methods stated in SAE J2711 shall be utilized.

**HYBRID FUEL ECONOMY**

The engine shall be tuned when delivered to provide optimized performance as specified above, including fuel economy. All related components and configuration that affect fuel economy, such as, fan control/operation, transmission, axle ratio, etc., shall be selected accordingly. The bus shall achieve an average fuel economy of 6.00 miles per gallon when run on the Transit Bus Duty Cycle loaded to SLW. Reference SAE J2711, Fuel Economy Measurement Test (Engineering Type) for Trucks and Buses.

**POWERPLANT**

**Engine**

The bus shall be powered by a heavy duty diesel engine, Cummins L9 with a minimum rating of 280 BHP at 2200 RPM and a peak torque of 900 foot lbs. at 1300 RPM, or Deviation. The engine shall comply with applicable local, state, and/or federal emissions and useful life requirements. The engine shall be designed to operate for not less than 300,000 miles without major failure or significant deterioration. Components of the fuel management and/or control system shall have a design life of not less than 150,000 miles without replacement or major service. The lifetime estimate is based on the design operating profile.

The diesel engine shall be compliant with the current EPA Engine Certification emission standards for urban bus engines under the so-called "Pull Ahead" provisions effective at the time the buses are ordered.

The engine shall meet all requirements of these technical specifications, when operating on transit fuel in the Charlotte area known as Ultra Low Sulfur Diesel (USLD) fuel with a sulfur content of less than fifteen (15) ppm and is compliant with the lubricity levels specified and certified by the engine manufacturer and consistent with the bus diesel fuel specification used by the Agency.

The engine shall be equipped with an electronically controlled management system that complies with SAE J1708 and SAE J1939, Recommended Practice for Serial Data Communications Between Microcomputer Systems in Heavy Duty Vehicle Applications, compatible with either 12- or 24-volt power distribution. The engine control
system shall be capable of transmitting and receiving electronic inputs and data from other drivetrain components and broadcasting that data to other vehicle systems. Communication between electronic drivetrain components and other vehicle systems shall be made using the communications networks. The engine’s electronic management system shall monitor operating conditions and provide instantaneous adjustments to optimize both engine and bus performance. The system shall be programmable to allow optimization of programmable features.

The engine starting system shall be protected by an interlock that prevents its engagement when the engine is running. Special equipment or procedures may be employed to start the bus when exposed to temperatures less than 30 °F for a minimum of four hours without the engine in operation. All cold weather starting aids, engine heating devices and procedures shall be of the type recommended by the engine manufacturer and approved by the Agency. The integration of all systems on the vehicle relative to engine idle speed shall be the responsibility of the vehicle manufacturer to meet the requirements of the transit property.

The engine control system shall protect the engine against progressive damage. The system shall monitor conditions critical for safe operation and automatically de-rate power and/or speed and initiate engine shutdown as needed. The alternator shall be an EMP rated at 400 amps, or deviation with an external electronic voltage regulator.

NOTE: Engine shut down devices for hot engine, low oil, and low coolant shall be of the latest current production design. A visual and audible indication will be provided in the driver’s area to indicate when a device has been activated. For safety, a 30-second over-rule switch shall be installed in the dash to permit the vehicle to be moved to a safe area.

Emergency Alarm

There shall be a press-to-ON silent electrical switch located in the sidewall panel near driver’s left knee position. Details shall be subject to approval of the Agency at the pre-production meeting. When the switch is actuated the green hoodlum emergency light shall flash, the destination sign shall change, a signal shall be sent to the mobile radio and the covert microphone microphone shall be activated. The flashing device shall be silent type and shall flash at a rate of 60 - 120 cycles per minute. The destination signs shall be changed to read:

a) Front and side destination sign, shall read "Emergency - please call 911".

b) Rear destination sign shall read, “CALL 911”.

Onboard Diagnostics Indicators

Critical systems or components shall be monitored with a built-in diagnostic system. This diagnostic system shall have visual and audible indicators. The diagnostic indicator lamp panel shall be located in clear sight of the driver, but need not be immediately in front of the driver. The intensity of indicator lamps shall permit easy determination of on/off status in bright sunlight but shall not cause a distraction or visibility problem at night. All indicators shall have a method of momentarily testing the operation of the lamp. Whenever possible, sensors shall be of the closed circuit type, so that failure of the circuit and/or sensor shall activate the malfunction indicator.

An audible alarm shall sound when certain malfunctions are detected by the diagnostic system. The audible alarm shall be loud enough for the driver to be aware of its operation and to be inclined to discontinue operation of the bus. The following malfunction and other indicators listed shall be supplied on all buses:

Automatic Engine Protection/Shutdown Override Feature

A control shall be available to the operator/driver that when constantly depressed and released will delay the engine shutdown for an additional 30 seconds or allow the bus to be moved. Override action shall be recorded. This data shall be retrievable by the Agency.
Propulsion System (Hybrid)

Propulsion System Description
The bus engine shall be a Cummins ISB heavy-duty diesel engine, with a minimum of 260BHP @ 2400RPM and peak torque of 620 foot lbs. @ 1600RPM, or Deviation. The Contractor shall meet the remainder of Engine section for diesel buses. The bus shall be powered by a BAE Series ER w/ APS 2 hybrid electric propulsion system, or Deviation. Function and operation of the bus shall be transparent to the Bus Operator and passengers. The OEM shall assure that the bus structure can successfully accept the installation of the propulsion system and be operated on the stated duty-cycle for a period of 12 years without a structural failure. At a minimum, propulsion system shall comply with applicable local, state, and/or federal emissions and useful life requirements. The propulsion system shall comply with local, state, and federal (maintenance) and other applicable sections.

The Hybrid Drive System shall be rated for the GVWR or greater of the bus.

Propulsion System Service
The propulsion system shall be arranged so that accessibility for all routine maintenance is assured. No special tools, other than dollies and hoists, shall be required to remove the propulsion system or any subsystems. However, the Agency shall recognize that properly rated test equipment and safe electrical work practices are essential when servicing high voltage hybrid components. Two (2) suitably trained technicians shall be able to remove, replace, and prepare a subsystem for service in less than sixteen (16) total combined labor-hours. The exhaust system, air cleaner, air compressor, starter (if used), alternator, radiator, all engine accessories, and any other component requiring service or replacement shall be easily removable. Contractor shall provide all specialty tools and diagnostic equipment required for maintaining the Propulsion System in accordance with Special Tools List.

Primary Propulsion Unit and Traction Motor
The PPU and traction motor may be configured in a variety of methods dependent upon type of drive, series and/or parallel. The definition of motor in the context of this specification assumes the device can provide or consume energy as well as provide or retard mechanical motion.

Energy Storage and Controller
Design and performance shall be provided to the Agency. Energy storage shall be of a commercial design capable of operating in the Agency transit environment. The primary charging of the energy storage system shall be accomplished by the on-board PPU and regenerative braking.

In the event external, stationary chargers/conditioners are required, Contractor shall provide all special tools required for maintaining this requirement in accordance with Special Tools List.

Energy storage system modules should be kept at an equal state of charge to provide a minimum life defined by contractor under the submitted lifecycle plan.

Thermal management will be provided to ensure optimal life and performance of the ESS over the environmental operating range.

Hybrid System Controller (HSC)
The HSC regulates energy flow throughout hybrid system components in order to provide motive performance and accessory loads, as applicable, while maintaining critical system parameters (e.g., voltages, currents, temperatures, etc.) within specified operating ranges.
The controller shall monitor and process inputs and execute outputs as appropriate to control the operation of all propulsion system components.

**Prime Power Unit (PPU)**
The PPU and related emission systems shall meet all applicable emissions and design/durability guidelines and standards.

Contractor shall provide Agency with expected durability of the PPU and related emission systems.

The PPU shall be equipped with an electronically controlled management system, compatible with multiplex wiring systems and either 12- or 24-volt electrical systems.

The engine shall have on-board diagnostic capabilities, able to monitor vital functions, store out-of-parameter conditions in memory, and communicate faults and vital conditions to service personnel. Diagnostic reader device connector ports, suitably protected against dirt and moisture, shall be provided in operator’s area and near or inside engine compartment. The on-board diagnostic system shall inform the operator via visual and/or audible alarms when out-of-parameter conditions exist for vital engine functions.

The engine starting system shall be protected by an interlock that prevents its engagement when the engine is running. Special equipment or procedures may be employed to start the engine when exposed to temperatures less than 30° F for a minimum of four hours without the engine in operation. All cold weather starting aids, engine heating devices and procedures shall be of the type recommended by the engine manufacturer and approved by the Agency.

**Standard Requirements for a Fast Idle Device**
The engine shall be equipped with an operator-controlled fast idle device. The fast idle control shall be a two-way switch mounted on the dash or side console and shall activate only with the transmission in neutral and the parking brake applied. The fast idle device shall have a setting of 900 RPM + 100/-50 RPM.

**Cooling Systems**
The cooling systems shall be of sufficient size to maintain all engine and transmission fluids and engine intake air at safe, continuous operating temperatures during the most severe operations possible and in accordance with engine and transmission manufacturers’ cooling system requirements. The cooling system fan controls should sense the temperatures of the operating fluids and the intake air, and if either is above safe operating conditions the cooling fan should be engaged. The fan control system shall be designed with a fail-safe mode of “fan on.” The cooling system shall meet the requirements stated in the operating environment.

**Engine Cooling**
The engine shall be cooled by a water-based, pressure type, cooling system that does not permit boiling or coolant loss during the operations described above. Engine thermostats shall be easily accessible for replacement. Shutoff valves shall allow filter replacement without coolant loss. Valves shall permit complete shutoff of lines for the heating and defroster units, and water booster pumps. The water boost pump shall be a magnetically coupled, brushless design. All low points in the water-based cooling system shall be equipped with drain cocks. Air vent valves shall be fitted at high points in the cooling system unless it can be demonstrated that the system is self-purging.

A means of determining satisfactory engine coolant level shall be provided. A spring-loaded, push-button type valve or lever shall be provided to safely release pressure or vacuum in the cooling system with both it and the water filler no more than +/- 60 in. above the ground. Both shall be accessible through the same access door.
The radiator and charge air cooler shall be of durable, corrosion-resistant construction with bolted-on removable tanks. Cooling fan system should be EMP mini hybrid thermal management system or. Deviation

The radiator shall be designed so a 2M mechanic can gain access to a substantial portion of the side facing the engine for the purpose of cleaning the radiator in five minutes or less.

There shall be no screen in front of the radiator.

**Standard Requirement for Coolant Filtration**
The engine cooling system shall be equipped with a properly sized water filter with a spin-on element and an automatic system for releasing supplemental coolant additives as needed to replenish and maintain protection properties. When replacing the water filter, only the water in the filter will be lost.

**Standard Control and Drive Design**
Control and drive of the radiator and charge air cooler fan(s) shall be the Contractor’s standard design.

**Self-Cleaning**
Radiator and charge air cooler fan(s) shall be electrically driven and capable of automated reverse operations for periodic self-cleaning of the radiator and charge air cooler.

**Standard Mounting Design**
Mounting location of radiator and charge air cooler shall be the Contractor’s standard design.

**Cooling Fan Controls EMP Deviation. Electric Fans**
The cooling fan shall be temperature controlled, allowing the engine to reach operating temperature quickly. The temperature-controlled fan shall not be driven when the coolant temperature falls below the minimum level recommended by the engine manufacturer.

**Charge Air Cooling**
The charge air cooling system also referred to as after-coolers or inter-coolers shall provide maximum air intake temperature reduction with minimal pressure loss. The charge air radiator shall be sized and positioned to meet engine manufacturer’s requirements. The charge air radiator shall not be stacked ahead of or behind the engine radiator and shall be positioned as close to the engine as possible unless integrated with the radiator. Air ducting and fittings shall be protected against heat sources and shall be configured to minimize restrictions and maintain sealing integrity.

**Transmission Cooling**
The transmission shall be cooled by a dedicated heat exchanger sized to maintain operating fluid within the transmission manufacturer’s recommended parameters of flow, pressure and temperature. The transmission cooling system shall be matched to retarder and engine cooling systems to ensure that all operating fluids remain within recommended temperature limits established by each component manufacturer. The engine cooling system should provide coolant bypass flow to the transmission cooling system with the engine thermostats closed.

**Hybrid Drive System Cooling**
Thermal management system shall maintain hybrid system components within design operating temperature limits.
Transmission (Conventional Powertrain)
The transmission shall be multiple speed, automatic shift with torque converter, retarder and electronic controls. Gross input power, gross input torque and rated input speed shall be compatible with the engine. The transmission shall be an Allison B400R or Deviation. A 3M mechanic, with optional assistance, shall be able to remove, replace, and prepare the transmission assembly for service in less than sixteen (16) total combined man-hours. The transmission shall be designed to operate for not less than 300,000 miles on the design operating profile without replacement or major service. The transmission should be easily removable without disturbing the engine and accessible for service. The transmission shall be equipped with a rebuildable, cleanable oil cooler. The transmission shall be shifted from the operator's left or right side area by means of electronic push button control.

The electronic controls shall be capable of transmitting and receiving electronic inputs and data from other drivetrain components and broadcasting that data to other vehicle systems. Communication between electronic drivetrain components and other vehicle systems shall be made using the SAE J1939 Recommended Practice communications link. Electronic controls shall be compatible with either 12- or 24-volt power distribution, provide consistent shift quality and compensate for changing conditions such as variations in vehicle weight and engine power.

A nominal brake pedal application of 6 to 10 psi shall be required by the driver to engage forward or reverse range from the neutral position to prevent sudden acceleration of the bus from a parked position.

The electronically controlled transmission shall have on-board diagnostic capabilities, be able to monitor functions, store and time stamp out-of-parameter conditions in memory, and communicate faults and vital conditions to service personnel. The transmission shall contain built-in protection software to guard against severe damage. The on-board diagnostic system shall trigger a visual alarm to the driver when the electronic control unit detects a malfunction. Trouble codes logged by the transmission Electronic Control Unit shall be permanently retained in the memory until removed by the proper service equipment. The system shall be equipped with two data link connections suitably protected against dirt and moisture, one located in the engine compartment and the second in the operator’s area.

An electronic transmission fluid level monitoring and protection system shall be provided.

Automatic Neutral Function
The transmission shall incorporate an automatic neutral shift function when the parking brake is applied

Automatic Neutral Function with Automatic Re-engagement
The transmission, when in forward direction, shall automatically shift the transmission to neutral when the vehicle registers zero road speed, engine is idle and service brakes are applied. If the status of any one or more of the three signals changes, the transmission immediately and automatically resumes forward mode operation.

Retarder
The powertrain shall be equipped with a retarder designed to extend brake lining service life. The application of the retarder shall cause a smooth blending of both retarder and service brake function and shall activate the brake lights.

Actuation of ABS and/or automatic traction control (ATC) shall override the operation of the brake retarder.
Throttle Pedal Activation of the Retarder
The retarder shall become partially engaged (approximately one-third of its total application, with a resulting deceleration of no greater than 0.077g) when the throttle pedal is completely released. Maximum retarder shall be achieved when brake pedal is depressed prior to engagement of service brakes, with a maximum resulting deceleration of approximately 0.20g in an empty bus. The resulting decelerations specified include the effects of engine braking, wind resistance and rolling resistance.

The thermostatically controlled cooling fan shall be activated when the retarder is engaged and the coolant temperature reaches the maximum operating temperature established by the engine and transmission manufacturers.

Accessible Retarder Disable Switch
The retarder disable switch shall be accessible to the seated driver.

Disabling retarder shall be recorded for Agency data collection.

Mounting

Diesel
The power plant shall be mounted in a compartment in the rear of the bus. All engine and transmission mounting points shall be mechanically isolated with resilient mounts that resist oils and other engine compartment fluids, to minimize transfer of vibration to the body structure.

Hybrid
The hybrid electric drive system shall be mechanically isolated to minimize transfer of vibration to the body structure as defined in Section 3.1.9.6. Mounts shall control movement of the system so as not to affect performance of accessories or cause strain in piping and wiring connections.

Service
The propulsion system shall be arranged for ease of access and maintenance. No special tools, other than dollies and hoists, shall be required to remove the HED. Two 3M mechanics shall be able to remove and replace the engine assembly in less than twelve (12) total combined labor hours. The muffler, exhaust system, air cleaner, air compressor, starter, alternator, radiator, all accessories and any other component requiring service or replacement shall be easily removable and independent of the engine and transmission removal. Accessory drive systems shall operate without unscheduled adjustment for no less than 50,000 miles on the design operating profile. These accessories shall be driven at speeds sufficient to assure adequate system performance during extended periods of idle operation and low route speed portion of the design operating profile. Belt guards shall be provided as required for safety and shall be sturdy in design and installation and readily removable. Belt guards shall be readily removable for service by removal of Lynch pins—threaded fasteners shall not be used. Lynch pins shall be secured by steel cable lanyards in the near vicinity of use. Accessories may be driven directly by the engine, electrically or hydraulically. The contractor shall maximize accessory motors to operate electrically at nominal inverter voltages.

An engine oil pressure gauge shall be provided in the engine compartment. These gauges shall be easily read during service and mounted in an area where they shall not be damaged during minor or major repairs.

Engine oil and the radiator filler caps shall be hinged to the filler neck and closed with spring pressure or positive locks to prevent leakage. All fluid fill locations shall be properly labeled to help ensure that correct fluid is added. All fillers shall be easily accessible with standard funnels, pour spouts and automatic dispensing equipment. The engine and transmission shall be equipped with self-locking dip sticks and permanent identification tags. Color-coded tags shall be applied on all fluid lines, within the engine compartment at the fittings, to identify all the
different fluids carried in lines. The tags shall be made of heavy duty plastic, that are impervious to all fluids found in the engine compartment, and shall withstand steam cleaning. The contractors proposed tag and coding system shall be presented for review at the pre-production meeting. All lubricant sumps shall be fitted with magnetic-type drain plugs.

**Unique Fluid (Lubricant) Fillers**
The engine, transmission and hydraulic reservoir shall each incorporate a unique lubricant fill fitting to prevent cross-contamination of lubricant types. Fitting types shall be specified by the Agency.

The engine and transmission shall be equipped with sufficient heavy-duty fuel and oil filters for efficient operation and to protect the engine and transmission between scheduled filter changes. To the extent practicable, the filters shall be of the spin-on, disposable type or integral with the engine. All filters shall be easily accessible and the filter bases shall be plumbed to ensure correct reinstallation.

An engine bypass oil filter shall be installed if recommended by the engine manufacturer.

**Engine Air Cleaner**
An air cleaner with a dry filter element and a graduated air filter restriction indicator shall be provided. Air cleaner housing shall be clamped together or secured with a single wing nut, not clamped with multiple nuts. The filter shall be removable by a 3M mechanic in ten (10) minutes or less. The location of the air intake system shall be designed to minimize the entry of dust and debris and to maximize the life of the air filter. The engine air duct shall be designed to minimize the entry of water into the air intake system. Drainage provisions shall be included to allow any water/moisture to drain prior to entry into air filter.

**Hydraulic Systems**
If used, the hydraulic system shall demonstrate a mean time between repairs in excess of 120,000 miles. Hydraulic system service tasks shall be minimized and scheduled no more frequently than those of other major coach systems. All elements of the hydraulic system shall be easily accessible for service or unit replacement. Critical points in the hydraulic system shall be fitted with service ports so that portable diagnostic equipment may be connected or sensors for an off-board diagnostic system permanently attached to monitor system operation when applicable. A tamper-proof priority system shall prevent the loss of power steering during operation of the bus if other devices are also powered by the hydraulic system.

The hydraulic system shall operate within the allowable temperature range as specified by the lubricant manufacturer.

**Hydraulic System Sensors**
Sensors in the main hydraulic system, excluding those in the power steering system, shall indicate on the driver’s on-board diagnostic panel conditions of low hydraulic fluid level.

**Fluid Lines**
All lines shall be rigidly supported to prevent chafing damage, Fatigue Failures, degradation and tension strain. Lines should be sufficiently flexible to minimize mechanical loads on the components. Lines passing through a panel, frame or bulkhead shall be protected by grommets (or similar devices) that fit snugly to both the line and the perimeter of the hole that the line passes through to prevent chafing and wear. Pipes and fluid hoses shall not be bundled with or used to support electrical wire harnesses.

Lines shall be as short as practicable and shall be routed or shielded so that failure of a line shall not allow the contents to spray or drain onto any component operable above the auto-ignition temperature of the fluid.
All hoses, pipes, lines and fittings shall be specified and installed per the manufacturer’s recommendations.

**Fittings and Clamps**

All clamps shall maintain a constant tension at all times, expanding and contracting with the line in response to temperature changes and aging of the line material. The lines shall be designed for use in the environment where they are installed. For example, high-temperature resistant in the engine compartment, resistant to road salts near the road surface, and so on.

Compression fittings shall be standardized to prevent the intermixing of components. Compression fitting components from more than one manufacturer shall not be mixed, even if the components are known to be interchangeable.

**Charge Air Piping**

Charge air piping and fittings shall be designed to minimize air restrictions and leaks. Piping shall be as short as possible, and the number of bends shall be minimized. Bend radii shall be maximized to meet the pressure drop and temperature rise requirements of the engine manufacturer. The cross-section of all charge air piping shall not be less than the cross-section of the intake manifold inlet. Any changes in pipe diameter shall be gradual to ensure a smooth passage of air and to minimize restrictions. Piping shall be routed away from heat sources as practicable and shielded as required to meet the temperature rise requirements of the engine manufacturer.

Charge air piping shall be constructed of stainless steel, aluminized steel or anodized aluminum, except between the air filter and turbocharger inlet, where piping may be constructed of fiberglass. Connections between all charge air piping sections shall be sealed with a short section of reinforced hose and secured with stainless steel constant tension clamps that provide a complete 360-degree seal.

**Radiator**

Radiator piping shall be stainless steel or brass tubing, and if practicable, hoses shall be eliminated. Necessary hoses shall be a premium, silicone rubber type that is impervious to all bus fluids. All hoses shall be secured with stainless steel clamps that provide a complete 360-degree seal. The clamps shall maintain a constant tension at all times, expanding and contracting with the hose in response to temperature changes and aging of the hose material.

**Oil and Hydraulic Lines**

Oil and hydraulic lines shall be compatible with the substances they carry. The lines shall be designed and intended for use in the environment where they are installed. For example, high-temperature resistant in the engine compartment, resistant to road salts near the road surface, and so on. Lines shall be capable of withstanding maximum system pressures. Lines within the engine compartment shall be composed of steel tubing where practicable, except in locations where flexible lines are required.

Hydraulic lines of the same size and with the same fittings as those on other piping systems of the bus, but not interchangeable, shall be tagged or marked for use on the hydraulic system only.

**Fuel**

**Fuel Lines**

Fuel and oil lines within the engine compartment shall be rigidly supported and shall be composed of steel tubing where practical except in locations where flexible lines are necessary. Flexible fluid lines shall be kept at a minimum and shall be as short as practical. They shall be routed or shielded so that failure of a line shall not allow fuel or oil to spray or drain onto any component operable above the auto-ignition temperature of the fluid. Flexible lines shall be Teflon hoses with braided stainless steel jackets and shall have standard SAE or JIC brass
or steel, reusable, swivel, end fittings. Premium hoses of alternative construction may be used with specific approval of the Agency. Hoses shall be individually supported and shall not touch one another or any part of the bus.

Fuel lines shall be rated and sized to prevent freezing and plugging due to condensation and/or fuel gelling in extreme winter.

The fuel lines forward of the engine bulkhead shall be in conformance to SAE Standard J149 Type 1 for copper tubing, corrosion-resistant stainless steel tubing or SAE Standard J844 for nylon tubing color coded orange.

**TS 17.2 Design and Construction**

The understructure shall consist of structural stainless steel for maximum durability, reduced maintenance, and weight and improved corrosion resistance. It shall be welded and Huck bolted throughout. Conventional bolt construction shall be with Grade 8 (traceable) hardware, and shall be used only where necessary to allow for routine disassembly (e.g., the closing cross member shall be bolted to allow for engine removal at overhaul). No movement at bolted joints shall be allowed.

**Fuel Tank(s)**

The fuel tank(s) shall be made of corrosion resistant stainless steel. The fuel tank shall be made of sufficiently heavy gauge 300 series or ASTM Spec. A240 stainless steel.

**Installation**

The fuel tank(s) shall be securely mounted to the bus to prevent movement during bus maneuvers.

The diesel fuel tank shall have sufficient capacity to provide the operating range specified in the Fuel Economy (Design Operating Profile) section of this RFP. The minimum usable capacity shall be 125 gallons. The fuel tank shall be stainless steel and shall be easily removable for cleaning or replacement. A minimum 3/8-inch diameter drain plug shall be provided to completely drain the fuel tank. The tank shall include inspection plates(s) to permit internal inspection and cleaning. Internal baffles and fuel pick-up location shall assure continuous full power operation of the bus for a minimum of fifteen (15) minutes traveling up a six (6) percent grade starting with no more than twenty-five (25) gallons of fuel above the useable minimum. The bus shall be able to idle for a minimum of ten (10) minutes on a six (6) percent down grade starting with ten (10) gallons of fuel above the useable minimum.

The materials used in mounting shall withstand the adverse effects of road salts, fuel oils, and accumulation of ice and snow for the life of the bus.

**Labeling**

The capacity, date of manufacture, manufacturer name, location of manufacture, and certification of compliance to Federal Motor Carrier Safety Regulation shall be permanently marked on the fuel tank(s). The markings shall be readily visible and shall not be covered with an undercoating material.

**Fuel Filler**

The fuel lines forward of the engine bulkhead shall be in conformance to SAE Standards.

**Dry-break fuel filler**

The fuel filler shall accommodate a nozzle that forms a locked and sealed connection during the refueling process to eliminate spills. Fuel shall not be allowed to flow into the tank unless the nozzle has been properly coupled, locked and sealed to the filler. With the nozzle open, fuel shall enter the tank at a fill rate of not less than 40 gallons per minute of foam-free fuel without causing the nozzle to shut off before the tank is full.
A nozzle shall automatically shut off when the tank is essentially full. Once disconnected, fuel shall not be allowed to flow through the nozzle at any time. Any pressure over 3 psi shall be relieved from the fuel tank automatically. An audible signal shall indicate when the tank is essentially full. The dry break system shall be compatible with the Agency's system, Emco Wheaton or The fuel filler cap shall be hinged.

**Emissions and Exhaust**

**Exhaust Emissions**
The engine and related systems shall meet all applicable emission and engine design guidelines and standards. The engine shall be in compliance with current Urban Bus emissions standards as promulgated by the EPA that are in effect at the time of the procurement. The Agency seeks to achieve substantially lower PM emissions with the installation of a DPF system.

**Exhaust System**
Exhaust gases and waste heat shall be discharged from the roadside rear corner of the roof. The exhaust pipe shall be stainless steel and of sufficient height to prevent exhaust gases and waste heat from discoloring or causing heat deformation to the bus. The entire exhaust system shall be adequately shielded to prevent heat damage to any bus component, including the exhaust after-treatment compartment area. The exhaust outlet shall be designed to minimize rain, snow or water generated from high-pressure washing systems from entering into the exhaust pipe and causing damage to the after-treatment. Design must be approved at Pre Production.

**Exhaust Aftertreatment**
An exhaust aftertreatment system will be provided to ensure compliance to all applicable EPA regulations in effect.

**Diesel Exhaust Fluid Injection**
If required by the engine manufacturer to meet NOx level requirements specified by EPA, a DEF injection system will be provided. The DEF system will minimally include a tank, an injector, a pump, an ECM and a selective catalytic converter. The tanks shall be designed to store DEF in the operating environment described in the “Operating Environment” section. The DEF fluid lines shall be designed to prevent the DEF from freezing. The DEF injection system shall not be damaged from a cold soak at 10 °F.

**Particulate Aftertreatment**
If required by the engine manufacturer to meet particulate level requirements specified by EPA, a particulate trap will be provided. The particulate trap shall regenerate itself automatically if it senses clogging. Regeneration cycles and conditions will be defined by the engine manufacturer.

**STRUCTURE**

**General**

**Design**
The structure of the bus shall be designed to withstand the transit service conditions typical of an urban duty cycle throughout its service life. The vehicle structural frame shall be designed to operate with minimal maintenance throughout the 12-year design operating profile. The design operating profile specified by the Agency shall be considered for this purpose. The chassis shall be stainless steel w/ integrated side impact barriers in the Low floor Section.
Altoona Testing
Prior to acceptance of first bus, the vehicle must have completed any FTA-required Altoona testing. Any items that required repeated repairs or replacement must undergo the corrective action with supporting test and analysis. A report clearly describing and explaining the failures and corrective actions taken to ensure any and all such failures will not occur shall be submitted to the Agency.

Structural Validation
Baseline Structural Analysis
The structure of the bus shall have undergone appropriate structural testing and/or analysis. At minimum, appropriate structural testing and analysis shall include Altoona testing or Finite Element Analysis (FEA).

Distortion
The bus, loaded to GVWR and under static conditions, shall not exhibit deflection or deformation that impairs the operation of the steering mechanism, doors, windows, passenger escape mechanisms or service doors. Static conditions shall include the vehicle at rest with any one wheel or dual set of wheels on a 6 in. curb or in a 6 in. deep hole.

Resonance and Vibration
All structure, body and panel-bending mode frequencies, including vertical, lateral and torsional modes, shall be sufficiently removed from all primary excitation frequencies to minimize audible, visible or sensible resonant vibrations during normal service.

All components—electrical, mechanical, and other connections—shall operate without degradation during and after exposure to vibration as encountered in normal service. Mechanical components shall be mounted to minimize transfer of vibrations to passengers.

Engine Compartment Bulkheads
The passenger and engine compartment shall be separated by fire-resistant bulkheads. The engine compartment shall include areas where the engine and exhaust system are housed. This bulkhead shall preclude or retard propagation of an engine compartment fire into the passenger compartment and shall be in accordance with the Recommended Fire Safety Practices defined in FTA Docket 90A, dated October 20, 1993. Only necessary openings shall be allowed in the bulkhead, and these shall be fire-resistant. Any passageways for the climate control system air shall be separated from the engine compartment by fire-resistant material. Piping through the bulkhead shall have fire-resistant fittings sealed at the bulkhead. Wiring may pass through the bulkhead only if connectors or other means are provided to prevent or retard fire propagation through the bulkhead. Engine access panels in the bulkhead shall be fabricated of fire-resistant material and secured with fire-resistant fasteners. These panels, their fasteners and the bulkhead shall be constructed and reinforced to minimize warping of the panels during a fire that will compromise the integrity of the bulkhead.

Crashworthiness
The bus body and roof structure shall withstand a static load equal to 150 percent of the curb weight evenly distributed on the roof with no more than a 6 in. reduction in any interior dimension. Windows shall remain in place and shall not open under such a load. These requirements must be met without the roof-mounted equipment installed.

The bus shall withstand a 25 mph impact by a 4000-pound automobile at any side, excluding doorways, along either side of the bus with no more than 3 in. of permanent structural deformation at seated passenger hip height. This impact shall not result in sharp edges or protrusions in the bus interior.
Exterior panels below the rub-rail and their supporting structural members shall withstand a static load of 2000 lbs applied perpendicular to the bus anywhere below the rub-rail by a pad no larger than 5 sq in. This load shall not result in deformation that prevents installation of new exterior panels to restore the original appearance of the bus.

**Corrosion**

The bus body shall be constructed using only inherently corrosion resistant materials and fasteners to minimize deterioration. The structure and any applied panels shall not require corrosion preventative coating or after treatment either during construction or throughout the service life of the bus. Detailing shall be kept simple; add-on devices and trim, where necessary shall be minimized and integrated into the basic design.

The bus shall resist corrosion from atmospheric conditions and road salts. The bus understructure and exterior shall maintain structural integrity and nearly maintain original appearance throughout its service life, provided it is maintained by the Agency in accordance with the procedures specified in the service manual. Metallic materials exposed to the elements and all joints and connections of dissimilar metals shall be corrosion-resistant and shall be protected from galvanic corrosion. Representative samples shall withstand a two-week salt spray test in accordance with ASTM Procedure B-117 with no visual or structural detrimental effects to normally visible surfaces, and nor significant structural degradation or weight loss of over one percent for other members or components. All exposed surfaces under the finished bus shall be generously sprayed with non-flammable resin type undercoating.

All interior and exterior metal surfaces shall be cleaned and treated to prevent rust and/or corrosion. After welding in areas where primer was previously applied, all joints shall be brushed to eliminate foreign matter and then the joint shall be cleaned with a phosphorus solution to provide a good base for good paint adhesion. Finally, the joint shall be painted with red oxide primer.

Aluminum panels shall be properly prepared and primed before final paint. All bolts, nuts, washers, clamps, clips, and similar parts, shall be zinc or cadmium plated or phosphate coated to prevent corrosion.

All exterior body seams, joints and overlapping panels shall be sealed against entry of water or dust. Where dissimilar metals meet, proper care shall be taken to prevent electrolytic corrosion.

**Towing**

Each towing device shall withstand, without permanent deformation, tension loads up to 1.2 times the curb weight of the bus within 20 degrees of the longitudinal axis of the bus. If applicable, the rear towing device(s) shall not provide a toehold for unauthorized riders. The method of attaching the towing device shall not require the removal, or disconnection, of front suspension or steering components. Removal of the bike rack is permitted for attachment of towing devices. Extended rear towing eyes which also protect the oil pan when the buses is lifted from the front are required.

A plug connector permanently mounted at the front of the bus shall provide for bus tail lamp, marker, stop and turn signal lamp operation as controlled from the towing vehicle. The connector shall include a spring-loaded dust- and water-resistant cap. The plug connector shall be a seven (7) wire receptacle assembly; Cole-Hersee No. 12063 or approved interchangeable equal. The pins shall be coated with corrosion resistant paste. The termination end of the receptacle shall be strain relieved and sealed against water entry. Pin wiring configuration shall be provided by the Agency at design review. Location, installation and pin wiring arrangement shall be approved by the Agency. Shop air connectors shall be provided at the front and rear of the bus and shall be capable of supplying all pneumatic systems of the bus with externally sourced compressed air. The location of these shop air connectors shall facilitate towing operations.
Provisions shall be made to connect air from the towing vehicle to the service brake application valve. These connections shall be in a readily accessible location in the front and rear of the bus, and be identified by blue color coded glad hand connections. Provisions shall also be made to connect air from the towing vehicle to the wet tank and to the parking brake relay valve. These connections shall be in a readily accessible location in the front and rear of the bus,

**Lifted (Unsupported) Front Axle and Flat Towing Capability**

Permanent, vehicle mounted, provisions shall be made for the Agency to recover the vehicle by lift towing at the front and rear using the Agency’s stinger equipped recovery vehicle with standard lift tow attachments. The Agency’s standard towing attachments are designed to pin to lift tow eyes at the front and rear of the bus. These standard Agency attachments will be available for review by the contractor at the first project meeting.

Provisions shall be made at the front of the vehicle to allow attachment of a rigid tow bar that shall permit flat towing of the bus, at curb weight. Each towing device shall accommodate a tow hook with a one (1) inch throat.

The towing devices, and tow bar design shall require specific approval of the Agency. The details of bus recovery and towing shall be discussed at the first Project Meeting. All buses should be equipped with skid plates to protect engine oil pan from damage when the vehicle is lifted and towed from the front.

**Jacking**

It shall be possible to safely jack up the bus, at curb weight, with a common 10-ton bottle or floor jack with or without special adapter, when a tire or dual set is completely flat and the bus is on a level, hard surface, without crawling under any portion of the bus. Jacking from a single point shall permit raising the bus sufficiently high to remove and reinstall a wheel and tire assembly. Jacking pads located on the axle or suspension near the wheels shall permit easy and safe jacking with the flat tire or dual set on a 6 in. high run-up block not wider than a single tire. Jacking and changing any one tire shall be completed by a 2M mechanic helper in less than thirty (30) minutes from the time the bus is approached. The bus shall withstand such jacking at any one or any combination of wheel locations without permanent deformation or damage. Jacking pads shall be painted safety yellow or orange for ease of identification.

**Hoisting**

The Contractor shall provide with the Proposal, a detailed description of recommended hoisting procedures. The Contractor’s procedures should include but not be limited to hoisting under the following conditions: The bus axles or jacking plates shall accommodate the lifting pads of a two post ( or a three-post if 60 ft articulated bus ) hoist system. Jacking plates, if used as hosting pads, shall be designed to prevent the bus from falling off the hoist. Other pads on the bus structure shall support the bus on jack stands independent of the hoist.

a) Routine daily maintenance to include inspection, fluid and tire changes, brake adjustment and replacement;

b) Suspension system maintenance and replacement;

c) Transmission, engine or power plant cradle removal;

d) Replacement of the rear or front axle assemblies.

The Contractor shall Provide the Agency with modification of existing hoists and procurement of new hoists that will safely and efficiently accommodate the buses.
Floor Design
The floor shall be essentially a continuous plane, except at the wheel housings and platforms. Where the floor meets the walls of the bus, as well as other vertical surfaces such as platform risers or heating ducts, the surface edges shall be blended with a circular section of radius not less than ¼ in. or installed in a fully sealed butt joint. Similarly, a molding or cover shall prevent debris accumulation between the floor and wheel housings and heating ducts. The vehicle floor may be inclined only along the longitudinal axis of the bus, and the incline shall be less than 3-1/2 degrees of the horizontal, except locally in the area of the entrance and exit doors, which shall have a lateral slope not exceeding 2 degrees to allow for drainage.

The urban transit configuration floor design shall consist of two levels (bi-level construction). Aft of the rear door extending to the rear settee riser, the floor height may be raised to a height no more than 21 in. above the lower level, with equally spaced steps. An increase slope shall be allowed on the upper level, not to exceed 3.5 degrees off the horizontal.

The suburban configuration floor design may be single level or consist of two levels (bi-level construction). If bi-level, aft of the front wheelchair securement area extending to the rear settee riser, the floor height may be raised to a height no more than 21 in. above the lower level, with equally spaced steps. An increase slope shall be allowed on the upper level, not to exceed 3.5 degrees off the horizontal.

Strength
The floor deck may be integral with the basic structure or mounted on the structure securely to prevent chafing or horizontal movement and designed to last the life of the bus. Sheet metal screws shall not be used to retain the floor, and all floor fasteners shall be serviceable from one side only. Any adhesives, bolts or screws used to secure the floor to the structure shall last and remain effective throughout the life of the coach. Tapping plates, if used for the floor fasteners, shall be no less than the same thickness as a standard nut, and all floor fasteners shall be secured and protected from corrosion for the service life of the bus.

The floor deck shall be reinforced as needed to support passenger loads. At GVWR, the floor shall have an elastic deflection of no more than 0.60 in. from the normal plane. The floor shall withstand the application of 2.5 times gross load weight without permanent detrimental deformation. The floor, with coverings applied, shall withstand a static load of at least 150 lbs applied through the flat end of a ½ in. diameter rod, with 1/32-inch radius, without permanent visible deformation.

Construction
The floor shall be comprised of a composite material and shall consist of the subfloor and the floor covering that will last the life of the bus. The floor as assembled, including the sealer, attachments and covering, shall be waterproof, non-hygroscopic and resistant to mold growth. The subfloor shall be resistant to the effects of moisture, including decay (dry rot). It shall be impervious to wood-destroying insects such as termites.

Platforms
Driver’s Area
The covering of platform surfaces and risers, except where otherwise indicated, shall be the same material as specified for floor covering. Aluminum trim shall be provided along top edges of platforms unless integral nosing is provided.
Driver’s Platform
The driver’s platform shall be of a height such that, in a seated position, the driver can see an object located at an elevation of 42 in. above the road surface, 24 in. from the leading edge of the bumper. Notwithstanding this requirement, the platform height shall not position the driver such that the driver’s vertical upward view is less than 15 degrees. A warning decal or sign shall be provided to alert the driver to the change in floor level. Figure 3 illustrates a means by which the platform height can be determined, using the critical line of sight.

FIGURE 3
Determining Platform Height

Farebox
Farebox placement should minimize impact to passenger access and minimize interference with the driver’s line of sight.

Driver Interface Required; Platform Needed to Bring Height to Driver Access
If the driver’s platform is higher than 12 in., then the farebox is to be mounted on a platform of suitable height to provide accessibility for the driver without compromising passengers’ access.

Rear Step Area to Rear Area
A maximum of two steps, with not more than 8.5-inch risers of uniform height, may be provided in the aisle rearward of the rear door post leading to a high-floor area in the rear of the bus. Steps shall be the width of the aisle as determined by the seating in the immediate area of the steps. Step structure shall be corrosion-resistant throughout the life of the bus. Each step shall simultaneously support 300-pound loads evenly distributed over any six (6) inch wide section of the tread without permanent deformation and with elastic deflection of no more than 0.125 inches. Each step tread shall support a load of 500 pounds evenly distributed over the center half of...
the tread without permanent deformation. The steps shall be sloped only sufficient to preclude water accumulation on the steps. All corners in the step-area shall have radii no less than one-quarter (1/4) inch to facilitate cleaning.

All step treads shall be of uniform depth, which shall be no less than eleven (11) inches, and the plane of the step treads shall be parallel to the plane of the floor. Treads shall be covered with, nonskid, heavy duty composition material that shall remain effective in all weather conditions. Color of the tread covering shall match the vestibule flooring. The edge of the high floor shall have no overhang at the step riser. The edge of the high floor and the end of the step tread shall have a bright, contrasting yellow band no less than two inches wide on the full width of the step. The color shall be permanently blended into the tread covering material.

**Wheel Housing**

**Design and Construction**

**Construction**

Wheel housings shall be constructed of stainless steel material and shall be no less than fourteen (14) gauge (0.0125-inch). The wheel housing shall be securely mounted and sealed to the bus body structure and they shall be isolated from dissimilar metals to prevent galvanic corrosion. Wheel housings, as installed, shall withstand impacts of a tire tread dislodging or stone throw at 55 mph, which is simulated by impacts of a two (2) inch steel ball with at least 200 foot-pounds of energy without penetration or visual deformation. Location and design of the construction of the wheel housing shall be submitted for the Agency approval at the pre-production meeting.

**Finish**

Each of the front wheel housings interior shall be covered with a single FRP panel with a twenty-five (25) percent gloss black gel coat finish. The FRP covers shall be securely mounted to the bus structure and shall withstand kicking and other abuse by boarding passengers and shall carry the structural loads of the attached passenger assists and electrical locker without visual or sensual deformation.

The rear wheel housings interior shall be covered with the same material as the bus flooring. Edges shall be trimmed with stainless steel or aluminum.

**Clearance**

Sufficient clearance and air circulation shall be provided around the tires, wheels, and brakes to preclude overheating when the bus is operating on the design operating profile. Tire chain clearance shall be provided on the outside driven wheels in accordance with SAE Information Report J683. Interface between the tires and any portion of the bus shall not be possible in maneuvers up to the limit of tire adhesion with weights from wet to GVWR..

(Reserved)

60 ft articulated buses shall be equipped with a turntable that permanently joins the lead unit and trailing unit sections, allows relative motion between the sections about the pitch and yaw axes, and allows a small amount of relative roll between the sections without damage. A rotating turntable connection shall be provided between the lead unit and trailing unit to serve as a floor and to allow passenger access between the sections of the bus under all operating conditions. The turntable design shall provide for all horizontal and vertical turns that the bus is capable of making without introducing discontinuities between the turntable and adjacent vehicle floors.

The structures and finishes in the interconnecting section shall be designed to prevent passenger injury under all conditions. The turntable floor cover plate shall be supported so that there will be no honing of the floor plate, making it sharp at the outer edge. The gap between the floor and the turntable shall be minimized in order to
prevent a tripping hazard. It shall be designed for ease of access for inspection and repairs of all devices that are part of it or devices that pass through the turntable area. Under-floor turntable components shall be easily accessible. Floor plates must be easily lifted and secured in the open position by one person for inspection and repairs. Turntable seats shall be quickly and easily removable by one person. The under-floor turntable area shall be completely enclosed by the bellows and bulkheads on the lead and trailing units to prevent drafts into the passenger compartment. The area between the turntable floor and the bellows shall be closed to prevent collection of trash in the bottom of the bellows. Closeouts shall be attached with removable fasteners. An access hatch shall be provided for routine maintenance (i.e., greasing, adjusting potentiometer, maintenance items).

An anti-jackknife joint shall be provided. This joint—by sensing vehicle speed, relative angle between the lead and trailing sections, throttle and braking actions, and any other necessary inputs—will control the degree of stiffness in the joint to ensure that the bus does not jackknife or operate in a dangerous or unsafe condition. The Agency shall approve the anti-jackknife joint. The interconnecting structure shall be designed to prevent separation of the lead and trailing units as a result of a road accident with a commercial or private vehicle. A means shall be provided so that the driver can override the control or recover from the situation. The bus shall be equipped with a reverse speed governor that shall apply the brake and accelerator interlocks when the bus speed in reverse gear exceeds 1.5 mph, but the bus shall have sufficient power in reverse to back out of wheel locator depressions at a floor hoist. The proposed configuration of these devices and the reverse-speed requirements shall be submitted for approval of the Agency.

Easy access shall be provided to overhead lines (electric, air, hydraulic, refrigerant) passing through the turntable. Hydraulic fittings shall be suitable for the given application and must be compatible with other fittings throughout the vehicle.

In order to prevent damage to the structure and electrical, air, hydraulic and refrigerant lines when the vertical or horizontal bending capabilities of the hinge are exceeded, the bus shall be provided with appropriate warning devices, brake interlocks and positive mechanical stops. These devices shall operate when the maximum bend angle is being approached in either plane.

**Raceway (Articulated Transit Coach)**

A raceway shall be provided through the turntable area to accommodate to maximum deflection of the turntable. The raceway shall prevent chafing, binding, rubbing, crimping or leakage of all hydraulic, air, fuel and system support lines, as well as all electrical and electronic cabling through or to the turntable area. Lines shall be secured, separated and labeled at the lead and trailing unit bulkheads. Separation shall be maintained on the flexible portion of all lines through the use of a raceway. All electrical terminations and hose fittings shall be easily visible and easily tightened or removed without removing any other component. Lines, routing, securement and labeling shall be approved by the Agency.

Bulkhead fitting shall be provided for all lines: air coolant, electrical and AC at both ends of the raceway. The bulkhead area shall be easily accessible for servicing.

**Bellows**

Replacement fabric type bellows with draft-free, no-sag bottom closure and water drains shall be provided between the lead and trailing sections to seal the bus interior and keep it free of water, dirt and drafts. Bellows hardware shall be corrosion resistant, and the under-floor area of the bellows shall be easy to clean when necessary. The passageway between the lead unit and trailing unit shall have an inside cross section that is as nearly equal as possible to the inside cross section of the bus bodies, with no tripping or pinching hazards created by the turntable cross section or closeouts. The bellows shall be durable, and its supporting structure and stiffeners shall support the bellows material in a neat, sag-free manner. The Contractor shall supply information on the
actual service life achieved by the type of bellows being proposed. A sample of the bellows and attaching hardware may be requested for evaluation at the Agency’s option. Bellows shall be approved by the Agency.

CHASSIS

Suspension

General Requirements
The front axle shall be a non-driving solid beam with a load rating sufficient for the bus loaded to GVWR. The front and rear suspensions shall be pneumatic type. The system will consist of four rear and two front Firestone Rolling Lobe, or equal, air bellows on the 40-foot buses and two rear and two front air bellows on the 30-foot buses. The basic suspension system shall last the service life of the bus without major overhaul or replacement. Items such as shock absorbers, radius rods, bushings, leveling valves and air springs shall be easily and quickly replaceable by a 2M mechanic. Adjustment points shall be minimized and shall not be subject to a loss of adjustment in service. A maximum of one of the four radius rod on each axle shall be of adjustable length. Routine adjustments shall be easily accomplished by limiting the removal or disconnecting the components. If radius rods and or radius rod ends are exposed to road hazards / obstructions, appropriate provisions must be made to ensure a radius rod or rod eyelet failure do not result in a loss of steering control.

Alignment

All axles should be properly aligned so the vehicle tracks accurately within the size and geometry of the vehicle.

Springs and Shock Absorbers

Suspension Travel
The suspension system shall permit a minimum wheel travel of 3.5 in. jounce-upward travel of a wheel when the bus hits a bump (higher than street surface), and 3 in. rebound-downward travel when the bus comes off a bump and the wheels fall relative to the body. Elastomeric bumpers shall be provided at the limit of jounce travel. Rebound travel may be limited by elastomeric bumpers or hydraulically within the shock absorbers. Suspensions shall incorporate appropriate devices for automatic height control so that regardless of load the bus height relative to the centerline of the wheels does not change more than ½ in. at any point from the height required. The safe operation of a bus cannot be impacted by ride height up to 1 in. from design normal ride height. Delco height control valves or equal are preferred.

Damping

Vertical damping of the suspension system shall be accomplished by hydraulic shock absorbers, Koni or, Deviation mounted to the suspension arms or axles and attached to an appropriate location on the chassis. Damping shall be sufficient to control coach motion to two cycles or less after hitting road perturbations. Shock absorbers shall maintain their effectiveness for at least 50,000 miles in normal service, and each unit shall be replaceable by a 2M mechanic in less than fifteen (15) minutes. The attachment points of the shock absorbers shall maintain their effectiveness for the life of the bus. The shock absorber bushing shall be made of elastomeric material that will last the life of the shock absorber. The damper shall incorporate a secondary hydraulic rebound stop.

Lubrication

Standard Grease Fittings
All elements of steering, suspension and drive systems requiring scheduled lubrication shall be provided with grease fittings conforming to SAE Standard J534. These fittings shall be located for ease of inspection and shall be accessible with a standard grease gun from a pit or with the bus on a hoist. Each element requiring lubrication
shall have its own grease fitting with a relief path. The lubricant specified shall be standard for all elements on the bus serviced by standard fittings and shall be required no less than every 6000 miles.

**Kneeling**

A driver-actuated kneeling system shall lower the entrance(s) of the bus a minimum of 2.5 in. during loading or unloading operations regardless of load up to GVWR, measured at the longitudinal centerline of the entrance door(s). The kneeling control shall provide the following functions:

- Downward control must be held to allow downward kneeling movement.
- Release of the control during downward movement must completely stop the lowering motion and hold the height of the bus at that position.
- Upward control actuation must allow the bus to return to normal floor height without the driver having to hold the control.

The brake and throttle interlock shall prevent movement when the bus is kneeled. The kneeling control shall be disabled when the bus is in motion. The bus shall kneel at a maximum rate of 1.25 in. per second at essentially a constant rate. After kneeling, the bus shall rise within 2 seconds to a height permitting the bus to resume service and shall rise to the correct operating height within 7 seconds regardless of load up to GVWR. During the lowering and raising operation, the maximum vertical acceleration shall not exceed 0.2g, and the jerk shall not exceed 0.3g/second.

An indicator visible to the driver shall be illuminated until the bus is raised to a height adequate for safe street travel. An audible warning alarm will sound simultaneously with the operation of the kneeler to alert passengers and bystanders. A warning light mounted near the curbside of the front door, a minimum 2.5 in. diameter amber lens, shall be provided that will blink when the kneel feature is activated. Kneeling shall not be operational while the wheelchair ramp is deployed or in operation.

**Wheels and Tires**

**Wheels**

Wheels and rims shall be Alcoa 8.25 x 22.5 high polished hub piloted Dura Flange wheels or equal. Commuter coach wheels shall be approved by the Agency. All wheels shall be interchangeable and shall be removable without a puller. Wheels shall be compatible with tires in size and load-carrying capacity. Front wheels and tires shall be balanced as an assembly per SAE J1986. Rear wheels must have sufficient spacing between dual tires to permit the use of skid chains. Wheel nuts shall be torqued to the manufacturer's specification with disc-locks of an inch size (not metric) on all lug nuts.

One extra mounted and balanced wheel and tire assembly shall be furnished with each bus.

A tire-pressure monitoring system shall be provided, to be approved by the Agency.

**Tires**

Tires shall be suitable for the conditions of transit service and sustained operation at the maximum speed capability of the bus. Load on any tire at GVWR shall not exceed the tire Supplier’s rating.

Low profile radial tires shall be provided under a lease agreement between the Agency and the tire Supplier. The Contractor shall provide the tire Supplier a minimum of sixty- days advance notice of their tire requirements. The Contractor shall be responsible for damage to or loss of tires while they are under the Contractor's control.
40-foot buses shall be capable of using standard size 12R22.5, 305/85R22.5 or equivalent; 30-foot buses shall be capable of using B275/70R22.5 or equivalent. Commuter coach tire size and type shall be approved by the Agency.

The Contractor shall apply an approved lubricant to each rim prior to mounting the tire assembly. The tires shall be so mounted that the position of the valve stem will locate the tire brand number inward, except the outside rear which shall be outward. The valve stems shall be those recommended by wheel manufacturer or Deviation approximately three (3) inches long with 31 degree bend. The rear wheel tire stems shall be aligned opposite each other at the rim opening to permit ease of service and fitted with (flow through ) extensions as needed to ensure ease of inside tire inflation. The Contractor shall furnish and install one Engler (less tenths) “million mile” drive-less type hubodometer on the curbside rear axle flange. The Hubodometer shall have the following minimum requirements: six (6) digits, three-sixteenth (3/16) high by one-eighth (1/8) inch wide numerals, Lexan cover with steel base, tamperproof and lifetime lubrication.

** Steering**

Hydraulically assisted steering shall be provided. Power steering shall be a Ross Model TAS65 or Deviation. The steering gear shall be an integral type with the number and length of flexible lines minimized or eliminated. All hydraulic lines shall be quick disconnect. Engine driven hydraulic pump shall be provided for power steering.

Fatigue life of all steering components shall exceed 1,000,000 miles. No element of the steering system shall fail before suspension system components when one of the tires strikes a severe road hazard. Inadvertent alterations of steering as a result of striking road hazards are steering failures.

** Please provide breakout cost for TRW or Electronic Assisted Steering.

** Steering Axle**

**Oiled-Type Front Bearings**

The front axle shall be non-driving with a load rating sufficient for the bus loaded to GVWR and shall be equipped with sealed, oiled-type front wheel bearings.

All friction points on the front axle shall be equipped with replaceable bushings or inserts and, if needed, lubrication fittings easily accessible from a pit or hoist.

The steering geometry of the outside (frontlock) wheel shall be within 2 degrees of true Ackerman up to 50 percent lock measured at the inside (backlock) wheel. The steering geometry shall be within 3 degrees of true Ackerman for the remaining 100 percent lock measured at the inside (backlock) wheel.

** Wheel**

**Turning Effort**

Steering effort shall be measured with the bus at SLW, stopped with the brakes released and the engine at normal idling speed on clean, dry, level, commercial asphalt pavement and the tires inflated to recommended pressure, with a full complement of fuel, oil, and coolant.

Under these conditions, the torque required to turn the steering wheel 10 degrees shall be no less than 5 ft-lbs and no more than 10 ft-lbs. Steering torque may increase to 30 ft-lbs when the wheels are approaching the steering stops, as the relief valve activates.

Power steering failure shall not result in loss of steering control. With the bus in operation, the steering effort shall not exceed 70 lbs at the steering wheel rim, and perceived free play in the steering system shall not materially
increase as a result of power assist failure. Gearing shall require no more than seven turns of the steering wheel lock-to-lock.

Caster angle shall be selected to provide a tendency for the return of the front wheels to the straight position with minimal assistance from the driver.

Steering Wheel, General
The steering wheel shall be no less than twenty (20) inches in diameter and shall be shaped for firm grip with comfort for long periods of time. The steering wheel shall be removable with a standard or universal puller. The steering wheel shall be the color black. The steering column shall be provided with a Douglas or Deviation tilt-type design and telescoping, with four positions, for maximum adaptability to individual operators. When steering column location is selected a positive lock shall engage to prevent inadvertent movement of column.

Steering Column Tilt
The steering column shall have full tilt capability with an adjustment range of no less than 40 degrees from the vertical and easily adjustable by the driver.

Steering Wheel Telescopic Adjustment
The steering wheel shall have full telescoping capability and have a minimum telescopic range of 2 in. and a minimum low-end adjustment of 29 in., measured from the top of the steering wheel rim in the horizontal position to the cab floor at the heel point.

<table>
<thead>
<tr>
<th>TABLE 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steering Wheel Height(^1) Relative to Angle of Slope</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Angle of Slope</th>
<th>Height</th>
<th>Angle of Slope</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 degrees</td>
<td>29 in.</td>
<td>0 degrees</td>
<td>34 in.</td>
</tr>
<tr>
<td>15 degrees</td>
<td>26.2 in.</td>
<td>15 degrees</td>
<td>31.2 in.</td>
</tr>
<tr>
<td>25 degrees</td>
<td>24.6 in.</td>
<td>25 degrees</td>
<td>29.6 in.</td>
</tr>
<tr>
<td>35 degrees</td>
<td>22.5 in.</td>
<td>35 degrees</td>
<td>27.5 in.</td>
</tr>
</tbody>
</table>

\(^1\) Measured from bottom portion closest to driver.

Drive Axle
The bus shall be driven by a heavy-duty, full floating rear axle. The drive axle shall be Meritor Standard or Deviation The drive axle shall be of a separate carrier housing construction with a load rating sufficient for the bus loaded to GVWR. The drive axle shall have a design life to operate for not less than 200,000 miles on the design operating profile without replacement or major repairs. Transfer of gear noise to the bus interior shall be minimized. All sealed surfaces shall be replaceable. The lubricant drain plug shall be magnetic type. If a planetary gear design is employed, the oil level in the planetary gears shall be easily checked through the plug or sight gauge. The axle and driveshaft components shall be rated for both propulsion and retardation modes with respect to duty cycle.

**NOTE:** The retardation duty cycle can be more aggressive than propulsion.

The drive shaft shall be guarded to prevent hitting any critical systems, including brake lines, coach floor or the ground, in the event of a tube or universal joint failure.
Non-Drive Axle
The non-drive axle is the drive axle without the drive gear with a load rating sufficient for the load to GVWR. The non-drive axle shall be Meritor or Deviation

Turning Radius

<table>
<thead>
<tr>
<th>Bus Length (approximate)</th>
<th>Maximum Turning Radius (see Figure 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 ft</td>
<td>30 ft (TR0)</td>
</tr>
<tr>
<td>40 ft</td>
<td>40 ft (TRO)</td>
</tr>
<tr>
<td>60 ft</td>
<td>44.5 ft (outside front axle, TRO)</td>
</tr>
</tbody>
</table>

Brakes

Service Brake
Brakes shall be self-adjusting S-cam brakes, fitted with automatic slack adjusters, Haldex or Deviation. Brake wear indicators (visible brake sensors) shall be provided on exposed push rods.

Actuation

Air-Actuated Brakes
Service brakes shall be controlled and actuated by a compressed air system. Force to activate the brake pedal control shall be an essentially linear function of the bus deceleration rate and shall not exceed 50 lbs at a point 7 in. above the heel point of the pedal to achieve maximum braking. The heel point is the location of the driver’s heel when his or her foot is rested flat on the pedal and the heel is touching the floor or heel pad of the pedal. The ECU for the ABS system shall be protected, yet in an accessible location to allow for ease of service.

Buses shall be equipped with a MGM E-Stroke brake system, which conforms to the requirements of all Federal and State of North Carolina regulations, designed so such conformance can be maintained throughout the normal adjustment cycle. A supplemental brake (transmission retarder) shall also be provided. The supplemental braking shall not be used in meeting regulatory criteria.

Braking forces shall be proportioned among the axles to assure balanced braking and equalize lining life between axles. Primary Braking shall be the rear axle.

The total braking effort shall be distributed between all wheels in such a ratio as to ensure equal friction material wear rate at all wheel locations. Manufacturer shall demonstrate compliance by providing a copy of a thermo dynamic brake balance test upon request.

Automatic Traction Control
Microprocessor controlled automatic traction control (ATC) shall be provided.

Friction Material
The entire service brake system, including friction material, shall have design overhaul or replacement life of at least 30,000 miles when running on the design operating profile with the transmission retarder activated. The brake linings shall be made of non-asbestos material. In order to aid maintenance personnel in determining extent of wear, a provision such as a scribe line or chamfer indicating the thickness at which replacement becomes
necessary shall be provided on each brake lining. The complete brake lining wear indicator shall be clearly visible from the hoist or pit without removing backing plates.

**Hubs and Drums**
Replaceable wheel bearing seals shall run on replaceable wear surfaces or be of an integral wear surface sealed design. Wheel bearing and hub seals and unitized hub assemblies shall not leak or weep lubricant for 100,000 miles when operating on the design operating profile for the duration of the initial manufacturer’s warranty.

**Drum Brakes**
The bus shall be equipped with brake drums. Brake drums shall allow machining for oversized linings per manufacturers specifications.

The brake system material and design shall be selected to absorb and dissipate heat quickly so that the heat generated during braking operation does not glaze brake linings. The heat generated shall not increase the temperature of the tire beads and wheel contact area to more than that allowed by the tire manufacture.

**Parking/Emergency Brake**

**Air Brakes**
The parking/emergency brake shall comply with FMVSS-121 and shall hold a bus stationary headed up or down with a full load on a twenty (20) percent grade.

**Interlocks**

**Passenger Door Interlocks**
To prevent opening mid and rear passenger doors while the bus is in motion, a speed sensor shall be integrated with the door controls to prevent the mid/rear doors from being enabled or opened unless the bus speed is less than 2 mph.

To preclude movement of the bus, an accelerator interlock shall lock the accelerator in the closed position, and a brake interlock shall engage the rear axle service brake system to stop movement of the bus when the driver’s door control is moved to a mid/rear door enable or open position, or a mid or rear door panel is opened more than 3 in. from the fully closed position (as measured at the leading edge of the door panel). The interlock engagement shall bring the bus to a smooth stop and shall be capable of holding a fully loaded bus on a 6 percent grade, with the engine at idle and the transmission in gear, until the interlocks are released. These interlock functions shall be active whenever the vehicle Master Run Switch is in any run position. The air pressure applied to the rear axle brakes when the interlock is applied shall be adjustable from outside the bus and shall require hand tools.

A rear door master switch, which is not within reach of the seated driver, shall, at OFF position, allow operation of the bus with the rear door locked and power to the rear door system disabled. When the rear door is disabled, the interlocks shall release and the driver’s door control shall be inoperative in the rear door open positions. The master switch shall be permanently labeled. Location and operation of the switch shall require concurrence of the Agency at the pre-production meeting.

All door systems employing brake and accelerator interlocks shall be supplied with supporting failure mode effects analysis (FEMA) documentation, which demonstrates that failure modes are of a failsafe type, thereby never allowing the possibility of release of interlock while an interlocked door is in and unsecured condition, unless the door master switch has been actuated to intentionally release the interlocks.
Requiring Accelerator Interlock Whenever Front Doors Are Open
An accelerator interlock shall lock the accelerator in the closed position, and a brake interlock shall engage the service brake system to stop movement of the bus whenever front doors are open.

Pneumatic System

General
The bus air system shall operate the air-powered accessories and the braking system with reserve capacity. New buses shall not leak down more than 5 psi over a 15-minute period of time as indicated on the dash gauge. For a period of not less than 72 hours after engine shut down, no part of the bus’s air system shall leak-down below 70 psi. To demonstrate compliance to the specification, the OEM shall perform a 72 hour leak down test on the first production bus. To expedite production a reduced twelve (12) hour leak down test must be performed on each production bus, during which the air pressure shall not be reduced by more than ten (10) psi.

Regardless of the system's air pressure, idle up to the rated engine speed shall be available to the driver with the transmission in neutral and the parking brake applied. The air compressor shall be a Wabco or Deviation with a minimum rated capacity of 23 CFM. Provision shall be made to apply shop air to the bus air systems using a standard type valve specified by the Agency. An Agency specified quick disconnect fitting shall be easily accessible and located in the engine compartment. Air for the compressor shall be filtered. The air system shall be protected per FMVSS 121.

Air Compressor
The engine-driven air compressor shall be sized to charge the air system from 40 psi to the governor cut-off pressure in less than 3 minutes while not exceeding the fast idle speed setting of the engine.

Air Lines and Fittings
Air lines, except necessary flexible lines, shall conform to the installation and material requirements of SAE Standard J844-Type 1 for copper tubing with standard, brass, flared or ball sleeve fittings, or SAE Standard J844-Type 3B for nylon tubing if not subject to temperatures over 200 °F. Accessory and other non-critical lines may use Type 3A tubing. The air on the delivery side of the compressor where it enters nylon housing shall not be above the maximum limits as stated in SAE J844. Nylon tubing shall be installed in accordance with the following color-coding standards:

- **Green:** Indicates primary brakes and supply.
- **Red:** Indicates secondary brakes.
- **Brown:** Indicates parking brake.
- **Yellow:** Indicates compressor governor signal.
- **Grey:** Indicates accelerator (if used). **Black:** Indicates accessories.

*Orange:* Indicates fuel. Line supports shall prevent movement, flexing, tension, strain and vibration. Copper lines shall be supported by looms to prevent the lines from touching one another or any component of the bus. To the extent practicable and before installation, the lines shall be pre-bent on a fixture that prevents tube flattening or excessive local strain. Copper lines shall be bent only once at any point, including pre-bending and installation. Rigid lines shall be supported at no more than 5-ft intervals. Nylon lines may be grouped and shall be supported at 24 in. intervals or less.

The compressor discharge line between powerplant and body-mounted equipment shall be flexible convoluted copper or stainless steel line, or may be flexible Teflon hose with a braided stainless steel jacket. Other lines necessary to maintain system reliability shall be flexible Teflon hose with a braided stainless steel jacket. End fittings shall be standard SAE or JIC brass or steel, flanged, reusable, swivel-type fittings. Premium hoses of alternative construction may be used with specific approval of the Agency. Flexible hoses shall be as short as
practicable and individually supported. They shall not touch one another or any part of the bus except for the supporting grommets. Flexible lines shall be supported at 2-ft intervals or less.

Air lines shall be cleaned and blown out before installation and shall be installed to minimize air leaks. All air lines shall be routed to prevent water traps to the extent possible. Air lines routed through the understructure shall be protected via an environmentally sealed cover plate. Grommets or insulated clamps shall protect the air lines at all points where they pass through understructure components.

**Air Reservoirs**

All air reservoirs shall meet the requirements of FMVSS Standard 121 and SAE Standard J10 and shall be equipped with guarded or flush type drain valves. Major structural members shall protect these valves and any automatic moisture ejector valves from road hazards. Reservoirs shall be sloped toward the drain valve. All air reservoirs shall have drain valves that discharge below floor level with lines routed to eliminate the possibility of water traps and/or freezing in the drain line. The air system shall be protected by a pressure relief valve set at 150 psi and shall be equipped with check valves and pressure protection valves to assure partial operation in case of line failures. The fitting shall be installed in all airlines regulated by an air pressure regulator for testing for proper pressure.

**Air System Dryer**

The bus shall be equipped with a spin-on cartridge type air dryer, SKF High Capacity Turbo 2000 (heated) with filtration plus option (STD) or Deviation. The air dryer shall prevent accumulation of moisture in the air system, rated for transit bus applications, and sized to meet all the requirements of the air system. Dryer purge time shall be compatible with the air compressor unload time to guarantee elimination of moisture and all contaminants from the air system. The Contractor shall provide test data indicating that the performance of the air system conforms to the requirements at the pre-production meeting. The air-dryer, mounting, location shall be protected by a dust shield. With the exception of the aforementioned dust shield no other bus equipment shall require removal to service the air dryer. Dryer installation shall conform to the original manufacturer’s recommendations. The air dryer shall be desiccant type, with electrically heated drain. Heater device shall be thermostatically controlled. The air dryer system shall require approval of the Agency at the pre-production meeting.

**ELECTRICAL, ELECTRONIC AND DATA COMMUNICATION SYSTEMS**

**Overview**

The electrical system will consist of vehicle battery systems and components that generate, distribute and store power throughout the vehicle. (e.g., generator, voltage regulator, wiring, relays, and connectors).

Electronic devices are individual systems and components that process and store data, integrate electronic information or perform other specific functions.

The data communication system consists of the bi-directional communications networks that electronic devices use to share data with other electronic devices and systems. Communication networks are essential to integrating electronic functions, both onboard the vehicle and off.

Information level systems that require vehicle information for their operations or provide information shall adhere to J1939 data standard.
Data communications systems are divided into three levels to reflect the use of multiple data networks:

- **Drivetrain level**: Components related to the drivetrain including the propulsion system components (engine, transmission and hybrid units), and anti-lock braking system (ABS), which may include traction control.

- **Information level**: Components whose primary function is the collection, control or display of data that is not necessary to the safe drivability of the vehicle (i.e., the vehicle will continue to operate when those functions are inoperable). These components typically consist of those required for automatic vehicle location (AVL) systems, destination signs, fare boxes, passenger counters, radio systems, automated voice and signage systems, video surveillance and similar components.

- **Multiplex level**: Electrical or electronic devices controlled through input/output signals such as discrete, analog and serial data information (i.e., on/off switch inputs, relay or relay control outputs). Multiplexing is used to control components not typically found on the drivetrain or information levels, such as lights; wheelchair lifts; doors; heating, ventilation and air conditioning (HVAC) systems; and gateway devices.

![FIGURE 5 Data Communications Systems Levels](image)

**Modular Design**

Design of the electrical, electronic and data communication systems shall be modular so that each electronic device, apparatus panel, or wiring bundle is easily separable from its interconnect by means of connectors. Each module, except the main body wiring harness, shall be removable and replaceable in less than thirty (30) minutes by a 3M mechanic.

Powerplant wiring shall be an independent wiring harness. Replacement of the engine compartment wiring harness(es) shall not require pulling wires through any bulkhead or removing any terminals from the wires.

**Environmental and Mounting Requirements**

The electrical system and its electronic components shall be capable of operating in the area of the vehicle in which they will be installed, as recommended in SAE J1455.

Electrical and electronic equipment shall not be located in an environment that will reduce the performance or shorten the life of the component or electrical system when operating within the design operating profile. As a recommendation, no vehicle component shall generate, or be affected by, electromagnetic interference or radio frequency interference (EMI/RFI) that can disturb the performance of electrical/electronic equipment as defined in SAE J1113 and UNECE Council Directive 95/54 (R 10).
The Agency shall follow recommendations from bus manufacturers and subsystem Suppliers regarding methods to prevent damage from voltage spikes generated from welding, jump starts, shorts, etc.

**Hardware Mounting**

The mounting of the hardware shall not be used to provide the sole source ground, and all hardware shall be isolated from potential EMI/RFI, as referenced in SAE J1113.

All electrical/electronic hardware mounted in the interior of the vehicle shall be inaccessible to passengers and hidden from view unless intended to be viewed. The hardware shall be mounted in such a manner as to protect it from splash or spray.

All electrical/electronic hardware mounted on the exterior of the vehicle that is not designed to be installed in an exposed environment shall be mounted in a sealed enclosure.

All electrical/electronic hardware and its mounting shall comply with the shock and vibration requirements of SAE J1455.

**General Electrical Requirements**

**Batteries**

**Low-Voltage Batteries (24V)**

**Four Maintenance-Free Batteries**

Four (4) dry cell AGM battery maintenance free, sealed battery units conforming to SAE Standard J537 shall be provided. Each battery shall be of premium construction and shall be fitted with threaded stud terminals and lifting handles. Batteries shall have a minimum of 2150 cold cranking amps. Each battery shall have a purchase date of no more than sixty (60) days from the date of release for shipment to the Agency.

Positive and negative terminals shall have different size studs, or the battery terminals and cables shall be arranged to prevent incorrect installation. Battery terminals shall be located for access in less than thirty (30) seconds with jumper cables.

No battery shall be installed in any bus or subjected to an electrical load until it has been charged in accordance with the battery manufacturer’s recommendations and is in a full state of charge. Immediately prior to the time that the bus is delivered to the Agency’s property the batteries shall be load tested to assure that they are fully charged. Batteries that fail this test shall be considered defective, removed from the bus and replaced. Replaced batteries shall be marked to indicate defect and shall not be used on these buses again.

**Battery Cables**

The battery terminal ends and cables shall be color-coded with red for the primary positive, black for negative and another color for any intermediate voltage cables. Positive and negative battery cables shall not cross each other if at all possible, be flexible and sufficiently long to reach the batteries with the tray in the extended position without stretching or pulling on any connection and shall not lie directly on top of the batteries. All battery compartment cable ends and ground cable ends in the engine compartment shall be coated with dielectric grease. Except as interrupted by the master battery switch, battery and starter wiring shall be continuous cables with connections secured by bolted terminals and shall conform to specification requirements of SAE Standard J1127 – Type SGT, SGX or GXL and SAE Recommended Practice J541.

2100 strand 4/0 cable or greater recommended.

Each voltage shall be color-coded.
Jump Start
A grey in color Whitaker plug, equipped with a dust cap and adequately protected from moisture, dirt and debris shall be provided in the engine compartment to jump-start the bus.

Battery Compartment
The battery compartment shall prevent accumulation of snow, ice and debris on top of the batteries and shall be vented and self-draining. It shall be accessible only from the outside of the vehicle and require no tool to attain access. No components, other than the batteries and associated wiring shall be installed within the battery compartment. All components within the battery compartment, and the compartment itself, shall be protected from damage or corrosion from the electrolyte. The inside surface of the battery compartment’s access door shall be electrically insulated, as required, to prevent the battery terminals from shorting on the door if the door is damaged in an accident or if a battery comes loose. The battery compartment door should have battery connection schematic affixed to the inside of door.

The vehicle shall be equipped with a 12VDC and 24VDC quick disconnect switch(es). The battery compartment door shall conveniently accommodate operation of the 12VDC and 24VDC quick disconnect switch(es).

The battery quick disconnect access door shall be identified with a decal. The decal size shall not be less than 3.5 \( \times \) 5 in. (8.89 \( \times \) 12.7 cm).

The battery hold-down bracket shall be constructed of a non-metallic material (plastic or fiberglass).

This access door shall not require any special locking devices to gain access to the switch, and it shall be accessible without removing or lifting the panel. The door shall be flush-fitting and incorporate a spring tensioner or equal to retain the door in a closed position when not in use.

The batteries shall be securely mounted on a stainless steel or equivalent tray that can accommodate the size and weight of the batteries. The battery tray shall pull out easily and properly support the batteries while they are being serviced. The tray shall allow each battery cell to be easily serviced and filled with either manual or automatic equipment. A locking device shall retain the battery tray to the stowed position.

If not located in the engine compartment, the same fire-resistant properties must apply to the battery compartment. No sparking devices should be located within the battery box.

Auxiliary Electronic Power Supply
If required, gel-pack, or any form of sealed (non-venting) batteries used for auxiliary power are allowed to be mounted on the interior of the vehicle if they are contained in an enclosed, non-airtight compartment and accessible only to maintenance personnel. This compartment shall contain a warning label prohibiting the use of lead-acid batteries.

Master Battery Switch
A single master switch shall be provided near the battery compartment for the disconnecting of all battery positives (12V and 24V), except for safety devices such as the fire suppression system and other systems as specified. The Master Battery Switch shall be accessible by its own designated piano hinged door. The location of the master battery switch shall be clearly identified on the exterior access panel, be accessible in less than 10 seconds for deactivation and prevent corrosion from fumes and battery acid when the batteries are washed off or are in normal service.
Turning the master switch off with the powerplant operating shall shut off the engine and shall not damage any component of the electrical system. The master switch shall be capable of carrying and interrupting the total circuit load.

**Low-Voltage Generation and Distribution**

The low-voltage generating system shall maintain the charge on fully charged batteries, except when the vehicle is at standard idle with a total low voltage generator load exceeding 70 percent of the low voltage generator nameplate rating.

Voltage monitoring and over-voltage output protection (recommended at 32V) shall be provided.

Dedicated power and ground shall be provided as specified by the component or system manufacturer. Cabling to the equipment must be sized to supply the current requirements with no greater than a 5 percent volt drop across the length of the cable.

**Circuit Protection**

All branch circuits, except battery-to-starting motor and battery-to-generator/alternator circuits, shall be protected by current-limiting devices such as circuit breakers, fuses or solid state devices sized to the requirements of the circuit. Electronic circuit protection for the cranking motor shall be provided to prevent engaging of the motor for more than 30 seconds at a time to prevent overheating. The circuit breakers or fuses shall be easily accessible for authorized personnel. Fuses shall be used only where it can be demonstrated that circuit breakers are not practicable. This requirement applies to in-line fuses supplied by either the Contractor or a Supplier. Fuse holders shall be constructed to be rugged and waterproof. All manual reset circuit breakers critical to the operation of the bus shall be mounted in a location convenient to the Agency mechanic with visible indication of open circuits. The Agency shall consider the application of automatic reset circuit breakers on a case-by-case basis. The Contractor shall show all in-line fuses in the final harness drawings. Any manually resettable circuit breakers shall provide a visible indication of open circuits. Any manually resettable circuit breakers shall provide a visible indication of open circuits.

Circuit breakers or fuses shall be sized to a minimum of 15 percent larger than the total circuit load. The current rating for the wire used for each circuit must exceed the size of the circuit protection being used.

**Grounds**

The battery shall be grounded to the vehicle chassis/frame at one location only, as close to the batteries as possible. When using a chassis ground system, the chassis shall be grounded to the frame in multiple locations, evenly distributed throughout the vehicle to eliminate ground loops. Chassis ground locations shall be on a non-painted surface and covered with dielectric grease. No more than four ground ring/spade terminal connections shall be made per ground stud. Electronic equipment requiring an isolated ground to the battery (i.e., electronic ground) shall not be grounded through the chassis.

**Low Voltage/Low Current Wiring and Terminals**

All power and ground wiring shall have double insulation, be waterproof, and conform to specification requirements of SAE Recommended Practice J1127, J1128 and J1292. Double insulation shall be maintained as close to the junction box, electrical compartment or terminals as possible. The requirement for double insulation shall be met by wrapping the harness with plastic electrical tape or by sheathing all wires and harnesses with non-conductive, rigid or flexible conduit.

Wiring shall be grouped, number stamped every 12 inches, and color-coded. Wiring harnesses shall not contain wires of different voltage classes unless all wires within the harness are insulated for the highest voltage present
in the harness. Kinking, grounding at multiple points, stretching, and exceeding minimum bend radius shall be prevented.

Strain-relief fittings shall be provided at all points where wiring enters electrical compartments. Grommets or other protective material shall be installed at points where wiring penetrates metal structures outside of electrical enclosures. Wiring supports shall be protective and non-conductive at areas of wire contact and shall not be damaged by heat, water, solvents or chafing.

To the extent practicable, wiring shall not be located in environmentally exposed locations under the vehicle. Wiring and electrical equipment necessarily located under the vehicle shall be insulated from water, heat, corrosion and mechanical damage. Where feasible, front to rear electrical harnesses should be installed above the window line of the vehicle.

All wiring harnesses over 5 ft long and containing at least five wires shall include 10 percent (minimum two wires) excess wires for spares. This requirement for spare wires does not apply to data links and communication cables. Wiring harness length shall allow end terminals to be replaced twice without pulling, stretching or replacing the wire. Large wires such as battery cables and terminals shall be crimped to the wiring according to the connector manufacturer’s recommendations for techniques and tools. The manufacturer may also provide techniques for soldering wires only if the wire is not stiffened above the terminal and no flux residue remains on the terminal. Battery cable connectors shall be crimped and soldered. All cable connectors shall be locking type, keyed and sealed, unless enclosed in watertight cabinets or vehicle interior. For wiring harness connectors, pins shall be removable, crimp contact type, of the correct size and rating for the wire being terminated. All supply-side terminations shall end in a socket, not a pin. Unused pin positions shall be sealed with sealing plugs. Adjacent connectors shall either use different inserts or different insert orientations to prevent incorrect connections. All cable connectors shall be placed to provide adequate space for ease of removal and disconnection. All electrical connectors subjected to environmental exposure outside the passenger compartment shall be corrosion resistant and splash proof.

All wiring connectors outside of junction boxes shall be Deutsch or Deviation, with the terminals coated with dielectric grease. Terminals shall be crimped, corrosion-resistant and full ring type or interlocking lugs, protected with glue type heat shrink. When using pressure type screw terminal strips, only stranded wire shall be used. Insulation clearance shall ensure that wires have a minimum of “visible clearance” and a maximum of two times the conductor diameter or 1/16 in., whichever is less. When using shielded or coaxial cable, upon stripping of the insulation, the metallic braid shall be free from frayed strands that can penetrate the insulation of the inner wires.

Ultra-sonic and T-splices may be used with 7 AWG or smaller wire. When a T-splice is used, it shall meet these additional requirements:

- It shall include a mechanical clamp in addition to solder on the splice.
- The wire shall support no mechanical load in the area of the splice.
- The wire shall be supported to prevent flexing.

All splicing shall be staggered in the harness so that no two splices are positioned in the same location within the harness.

Wiring located in the engine compartment shall be routed away from high-heat sources or shielded and/or insulated from temperatures exceeding the wiring and connector operating requirements.

The instrument panel and wiring shall be easily accessible for service from the driver’s seat or top of the panel. The instrument panel shall be separately removable and replaceable without damaging the instrument panel or gauges. Wiring shall have sufficient length and be routed to permit service without stretching or chafing the wires.
Electrical Components

All electrical components, including switches, relays, flashers and circuit breakers, shall be heavy-duty designs with either a successful history of application in heavy-duty vehicles or design specifications for an equivalent environment. These components shall be longest lasting, commercially available, designed to last the service life of the bus and shall be replaceable in less than five (5) minutes by a 3M mechanic.

All electric motors shall be heavy-duty brushless type where practical, and have a continuous duty rating of no less than 40,000 hours (except cranking motors, washer pumps and wiper motors). All electric motors shall be easily accessible for servicing and except for the cranking motor, shall be replaceable in less than fifteen (15) minutes by a 3M mechanic.

Electrical Compartments

All relays, controllers, flashers, circuit breakers and other electrical components shall be mounted in easily accessible electrical compartments. All compartments exposed to the outside environment shall be corrosion-resistant and sealed to prevent moisture from normal sources, including engine compartment cleaning. Compartments shall prevent fire that may occur inside the box from propagating outside the box. The components and their functions in each electrical compartment shall be identified and their location permanently recorded on a drawing attached to the inside of the access panel or door. The drawing shall be protected from oil, grease, fuel and abrasion.

The front compartment shall be completely serviceable from the driver’s seat, vestibule or from the outside. “Rear start and run” controls shall be mounted in an accessible location in the engine compartment and shall be protected from the environment.

General Electronic Requirements

If an electronic component has an internal real-time clock, it shall provide its own battery backup to monitor time when battery power is disconnected, and/or it may be updated by a network component. If an electronic component has an hour meter, it shall record accumulated service time without relying on battery backup.

All electronic component Suppliers shall ensure that their equipment is self-protecting in the event of shorts in the cabling, and also in over-voltage (over 32V DC on a 24V DC nominal voltage rating with a maximum of 50V DC) and reverse polarity conditions. If an electronic component is required to interface with other components, it shall not require external pull-up and/or pull-down resistors. Where this is not possible, the use of a pull-up or pull-down resistor shall be limited as much as possible and easily accessible and labeled.

Wiring and Terminals

Kinking, grounding at multiple points, stretching and reducing the bend radius below the manufacturer’s recommended minimum shall not be permitted.

Discrete I/O (Inputs/Outputs)

All wiring to I/O devices, either at the harness level or individual wires, shall be labeled, stamped or color-coded in a fashion that allows unique identification at a spacing not exceeding 4 in. Wiring for each I/O device shall be bundled together. If the I/O terminals are the same voltages, then jumpers may be used to connect the common nodes of each I/O terminal.

Shielding

All wiring that requires shielding shall meet the following minimum requirements. A shield shall be generated by connecting to a ground, which is sourced from a power distribution bus bar or chassis. A shield shall be connected at one location only, typically at one end of the cable. However certain standards
or special requirements, such as SAE J1939 or RF applications, have separate shielding techniques that also shall be used as applicable. **NOTE:** A shield grounded at both end forms a ground loop, which can cause intermittent control or faults.

When using shielded or coaxial cable, upon stripping of the insulation, the metallic braid shall be free from frayed strands, which can penetrate the insulation of the inner wires. To prevent the introduction of noise, the shield shall not be connected to the common side of a logic circuit.

**Communications**

The data network cabling shall be selected and installed according to the selected protocol requirements. The physical layer of all network communication systems shall not be used for any purpose other than communication between the system components, unless provided for in the network specifications.

Communications networks that use power line carriers (e.g., data modulated on a 24V-power line) shall meet the most stringent applicable wiring and terminal specifications.

**Radio Frequency (RF)**

RF components, such as radios, video devices, cameras, global positioning systems (GPS), etc., shall use coaxial cable to carry the signal. All RF systems require special design consideration for losses along the cable. Connectors shall be minimized, since each connector and crimp has a loss that will attribute to attenuation of the signal. Cabling should allow for the removal of antennas or attached electronics without removing the installed cable between them. If this cannot be done, then a conduit of sufficient size shall be provided for ease of attachment of antenna and cable assembly. The corresponding component vendors shall be consulted for proper application of equipment, including installation of cables.

**Audio**

Cabling used for microphone level and line level signals shall be 22 AWG minimum with shielded twisted pair. Cabling used for amplifier level signals shall be 18 AWG minimum.

**Multiplexing**

**General**

The primary purpose of the multiplexing system is control of components necessary to operate the vehicle. This is accomplished by processing information from input devices and controlling output devices through the use of an internal logic program.

Versatility and future expansion shall be provided for by expandable system architecture. The multiplex system shall be capable of accepting new inputs and outputs through the addition of new modules and/or the utilization of existing spare inputs and outputs. All like components in the multiplex system shall be modular and interchangeable with self-diagnostic capabilities. The modules shall be easily accessible for troubleshooting electrical failures and performing system maintenance. Multiplex input/output modules shall use solid-state devices to provide extended service life and individual circuit protection.

Ten percent of the total number of inputs and outputs, or at least one each for each voltage type utilized (0V, 12V, 24V), at each module location shall be designated as spares.

**System Configuration**

Multiplexing may either be distributed or centralized. A distributed system shall process information on multiple control modules within the network. A centralized system shall process the information on a single control module. Either system shall consist of several modules connected to form a control network.
I/O Signals

The input/output for the multiplex system may contain three types of electrical signals: discrete, analog or serial data.

Discrete signals shall reflect the on/off status of switches, levers, limit switches, lights, etc. Analog signals shall reflect numerical data as represented by a voltage signal (0-12V, 10-24V, etc.) or current signal (4-20 mA). Both types of analog signals shall represent the status of variable devices such as rheostats, potentiometers, temperature probes, etc. Serial data signals shall reflect ASCII or alphanumeric data used in the communication between other on-board components.

The bus shall be equipped with an intelligent network system that will have the ability to communicate with various modules located throughout the bus. The Dinex system is preferred. The power supply to the intelligent network system shall be isolated to prevent avoiding any ground noise. The communication network shall utilize the SAE J1939 communication protocol. The system shall be capable of interfacing with the communication protocols utilized by all of the bus’ systems (e.g. engine, transmission, HVAC and brakes). Interruption of the communication signal shall cause the Main Bus Controller (MBC) to direct communications and announce the failure to the driver via the telltale LED warning lamp. The system shall be so designed to significantly reduce the connectors, circuit breakers and wiring harnesses of the bus. It shall have the capability to quickly troubleshoot electrical failures for the mechanic and notify maintenance personnel when an electrical component has failed.

The components of the multiplex system shall be of modular design, providing ease of replacement by maintenance personnel. The modules shall be easily accessible for trouble-shooting electrical failures and performing system maintenance. Each module shall be shielded to prevent interference by EMI and RFI; and shall utilize LED’s to indicate circuit integrity and assist in rapid circuit diagnostics and verification of the load and wiring integrity. All individual loads that require a maximum current of ten (10) amperes continuous or twenty (20) amperes intermittently shall be driven directly form a multiplex module without the use of relays. Selected individual multiplex system outputs should be capable of driving loads up to thirty (30) Amperes continuously with the use of relays. Output of MUX modules shall be protected against over current and short circuits.

Wiring for data bus and node module power shall consist of three (3), twenty-two (22) gauge or larger, UL approved, shielded, twisted pairs. A schematic drawing identifying all circuitry controlled at that location shall be permanently mounted or printed on the inside of each compartment containing a Multiplex module. The drawing shall be protected from oil, grease, fuel and abrasion.

Twenty (20) percent spare input and output shall be provided at each I/O location. Wiring used for multiplexing shall be stamped with the address of the corresponding I/O location.

The systems shall be equipped with a 32K byte diagnostic logger which will collect system anomalies. The logger shall provide monitoring capability of all information broadcast to the multiplex system via the J1939 compunction data loop and pertinent information of input/output failures.

The control system shall be equipped to accommodate a wireless diagnostic system. An RF Host Network Controller with integrated palm size PDA shall be able to communicate in real-time with the vehicles Multiplex system. The RF diagnostic tool shall be capable of troubleshooting and testing the communication loop and all inputs and outputs of the Multiplex system in real-time and provide pass/fail feedback to the operator. To further assist in troubleshooting an optional ladder logic format shall be incorporated into the design.
Data Communications

General
All data communication networks shall be either in accordance with a nationally recognized interface standard, such as those published by SAE, IEEE or ISO, or shall be published to the Agency with the following minimum information:

- Protocol requirements for all timing issues (bit, byte, packet, inter-packet timing, idle line timing, etc.)
- Packet sizes, error checking and transport (bulk transfer of data to/from the device).
- Data definition requirements that ensure access to diagnostic information and performance characteristics.
- The capability and procedures for uploading new application or configuration data.
- Access to revision levels of data, application software and firmware.
- The capability and procedures for uploading new firmware or application software.
- Evidence that applicable data shall be broadcast to the network in an efficient manner such that the overall network integrity is not compromised.

Any electronic vehicle components used on a network shall be conformance tested to the corresponding network standard.

Drivetrain Level
Drivetrain components, consisting of the engine, transmission, retarder, anti-lock braking system and all other related components, shall be integrated and communicate fully with respect to vehicle operation with data using SAE Recommended Communications Protocols such as J1939 and/or J1708/J1587 with forward and backward compatibilities or other open protocols.

Diagnostics, Fault Detection and Data Access
Drivetrain performance, maintenance and diagnostic data, and other electronic messages shall be formatted and transmitted on the communications networks.

The drivetrain level shall have the ability to record abnormal events in memory and provide diagnostic codes and other information to service personnel. At a minimum, this network level shall provide live/fail status, current hardware serial number, software/data revisions and uninterrupted timing functions.

Programmability (Software)
The drivetrain level components shall be programmable by the Agency with limitations as specified by the sub-system Supplier.

Multiplex Level
Data Access
At a minimum, information shall be made available via a communication port on the multiplex system. The location of the communication port shall be easily accessible. A hardware gateway and/or wireless communications system are options if requested by the Agency. The communication port(s) shall be located as specified by the Agency.

Diagnostics and Fault Detection
The multiplex system shall have a proven method of determining its status (system health and input/output status) and detecting either active (online) or inactive (offline) faults through the use of on-board visual/audible indicators.
In addition to the indicators, the system shall employ an advanced diagnostic and fault detection system, which shall be accessible via either a personal computer or a handheld unit. Either unit shall have the ability to check logic function. The diagnostic data can be incorporated into the information level network or the central data access system.

**Provide Mock-Up Board**
A mock-up board, where key components of the multiplexing system are replicated on a functional model, shall be provided as a tool for diagnostic, design verification and training purposes. If required, the mock-up board should priced separately in the Pricing Schedule.

The engine shall have onboard diagnostic capabilities, able to monitor vital function, store out of parameter conditions in memory, and communicate faults and vital conditions to service personnel. Trouble codes logged by the ECM shall be permanently retained in the ECM memory until removed with proper service equipment. The system must be equipped with two data link connections: one located in the engine compartment and the second located in the driver’s area.

In order to avoid potential warranty disputes during engine warranty period, initial performance settings shall only be changed with the authorization from bus and engine manufacturers. Data stored by said system shall be easily extractable via hard wire link and capable of transmission via the communications system. Conversely, the system shall be capable of similar modes of communications to upload various engine control settings inherent to the engine control system software architecture. Furthermore, the manufacturer shall provide the Agency with samples of pre-formatted engine performance/management reports (e.g. Fuel Management, Idle & RPM trip performance, etc.) featured in the proposed engine control system software architecture.

The on-board diagnostic system shall trigger a visual and audible alarm to the operator when the engine control unit or the fire suppression system detects a malfunction and the engine protection system is activated. Automatic shutdown shall occur within ten (10) seconds only when parameters established for the following functions are exceeded:

a) Coolant temperature
b) Oil pressure
c) Engine exhaust back pressure
d) DPF temperature
e) Engine compartment fire.

f) Low coolant
g) Under inflated tires
h) Overheated brakes

**Programmability (Software)**
The multiplex system shall have security provisions to protect its software from unwanted changes. This shall be achieved through any or all of the following procedures:

- password protection
- limited distribution of the configuration software
• limited access to the programming tools required to change the software
• hardware protection that prevents undesired changes to the software

Provisions for programming the multiplex system shall be possible through a PC or laptop. The multiplex system shall have proper revision control to ensure that the hardware and software are identical on each vehicle equipped with the system. Revision control shall be provided by all of the following:

• hardware component identification where labels are included on all multiplex hardware to identify components
• hardware series identification where all multiplex hardware displays the current hardware serial number and firmware revision employed by the module
• software revision identification where all copies of the software in service displays the most recent revision number
• a method of determining which version of the software is currently in use in the multiplex system

Revision control labels shall be physically located near the programming port.

Electronic Noise Control
Electrical and electronic sub-systems and components on all buses shall not emit electromagnetic radiation that will interfere with on-board systems, components or equipment, telephone service, radio or TV reception or violate regulations of the Federal Communications Commission.

Electrical and electronic sub-systems on the coaches shall not be affected by external sources of RFI/EMI. This includes, but is not limited to, radio and TV transmission, portable electronic devices including computers in the vicinity of or onboard the buses, ac or dc power lines and RFI/EMI emissions from other vehicles.

DRIVER PROVISIONS, CONTROLS AND INSTRUMENTATION

Driver’s Area Controls

General
The driver’s area shall contain all apparatus and controls necessary for operation of the bus. The layout shall maximize the use of available space and shall employ sound human factors and industrial design principles. The operator’s area and equipment shall be designed to ensure safe and optimal performance for operators in the range of the 5th percentile female to the 95th percentile male. The operator’s area shall be free of sharp edges, protruding objects, safety hazards and floor obstructions. Each requirement of this section is subject to Agency approval at the pre-production meetings.

In general when designing the driver’s area, it is recommended that SAE J833, “Human Physical Dimensions,” be used. An Agency Approved Driver Protection Barrier should be provided.

Switches and controls shall be divided into basic groups and assigned to specific areas, in conformance with SAE Recommended Practice J680, Revised 1988, “Location and Operation of Instruments and Controls in Motor Truck Cabs,” and be essentially within the hand reach envelope described in SAE Recommended Practice J287, “Driver Hand Control Reach.”

Glare
The driver’s work area shall be designed to minimize glare to the extent possible. Objects within and adjacent to this area shall be matte black or dark gray in color wherever possible to reduce the reflection of light onto the windshield. The use of polished metal and light-colored surfaces within and adjacent to the driver’s area shall be avoided.
Visors/Sun Shades

**Driver's Window Sunscreens**
An adjustable roller type sunscreen shall be provided over the driver’s windshield and/or the driver’s side window. The sunscreen shall be capable of being lowered to the midpoint of the driver’s window. When deployed, the screen shall be secure, stable and shall not rattle, sway or intrude into the driver’s field of view due to the motion of the coach or as a result of air movement. Once lowered, the screen shall remain in the lowered position until returned to the stowed position by the driver. Sunscreen shall be shaped to minimize light leakage between the visor and windshield pillars to the extent possible.

**Driver’s Controls**
Frequently used controls must be in easily accessible locations. These include the door control, kneel control, windshield wiper/washer controls, ramp, and lift and run switch. Any switches and controls necessary for the safe operation of the bus shall be conveniently located and shall provide for ease of operation. They shall be identifiable by shape, touch and permanent markings. Controls also shall be located so that passengers may not easily tamper with control settings.

All panel-mounted switches and controls shall be marked with easily read identifiers. Graphic symbols shall conform to SAE Recommended Practice J2402, “Road Vehicles – Symbols For Controls, Indicators, and Tell Tales,” where available and applicable. Color of switches and controls shall be dark with contrasting typography or symbols.

Mechanical switches and controls shall be replaceable, and the wiring at these controls shall be serviceable from a convenient location. Switches, controls and instruments shall be dust- and water-resistant.

**Normal Bus Operation Instrumentation and Controls**
The following images are representative of the Agency’s current configuration of bus controls used to operate the bus. These controls are either frequently used or critical to the operation of the bus. They shall be located within easy reach of the operator. The operator shall not be required to stand or turn to view or actuate these controls unless specified otherwise.

Systems or components monitored by onboard diagnostics system shall be displayed in clear view of the operator and provide visual and/or audible indicators. The intensity of indicators shall permit easy determination of on/off status in bright sunlight but shall not cause a distraction or visibility problem at night. All indicators shall be illuminated using backlighting.

The indicator panel shall be located in Area 1 or Area 5, within easy view of the operator instrument panel. All indicators shall have a method of momentarily testing their operation. The audible alarm shall be tamper-resistant and shall have an outlet level between 80 and 83 dBA when measured at the location of the operator’s ear.

On-board displays visible to the operator shall be limited to indicating the status of those functions described herein that are necessary for the operation of the bus. All other indicators needed for diagnostics and their related interface hardware shall be concealed and protected from unauthorized access. The intent of the overall physical layout of the indicators shall be in a logical grouping of systems and severity nature of the fault.

Consideration shall be provided for future additions of spare indicators as the capability of onboard diagnostic systems improves. Blank spaces shall contain LEDs.

**IMAGE 1**
Main Console
**IMAGE 2**
Transmission (Top Left) Console

**IMAGE 3**
Left-Hand Console
**Driver Foot Controls**
Accelerator and brake pedals shall be designed for ankle motion. Foot surfaces of the pedals shall be faced with wear-resistant, nonskid, replaceable material.

**Pedal Angle**
The vertical angle of the accelerator and brake pedals shall be determined from a horizontal plane regardless of the slope of the cab floor. The accelerator and brake pedals shall be positioned at an angle of 37 to 50 degrees at the point of initiation of contact and extend downward to an angle of 10 to 18 degrees at full throttle.

The location of the brake and accelerator pedals shall be determined by the manufacturer, based on space needs, visibility, lower edge of windshield, and vertical H-point.

**Pedal Dimensions and Position**
The floor-mounted accelerator pedal shall be 10 to 12 in. long and 3 to 4 in. wide. Clearance around the pedal must allow for no interference precluding operation.

**1 to 2 in. Between Brake and Accelerator Pedals**
The accelerator and brake pedals shall be positioned such that the spacing between them, measured at the heel of the pedals, is between 1 and 2 in. Both pedals should be located approximately on the same plane coincident to the surface of the pedals.

**Brake and Accelerator Pedals**

**Brake Pedal**
Non-adjustable brake pedal.

**Driver Foot Switches**

**Floor-Mounted Foot Control Platform**
The angle of the turn signal platform shall be determined from a horizontal plane, regardless of the slope of the cab floor. The turn signal platform shall be angled at a minimum of 10 degrees and a maximum of 37 degrees. It shall be located no closer to the seat front than the heel point of the accelerator pedal.

**Turn Signal Controls**
Turn signal controls shall be floor-mounted, foot-controlled, water-resistant, heavy-duty, momentary contact switches.

**Foot Switch Control**
The control switches for the turn signals shall be mounted on an inclined, floor-mounted stainless steel enclosure or metal plate mounted to an incline integrated into the driver’s platform, located to the left of the steering column. The location and design of this enclosure shall be such that foot room for the operator is not impeded. The inclined mounting surface shall be skid-resistant. All other signals, including high beam shall be in approved location.

The foot switches shall be UL-listed, heavy-duty type, of a rugged, corrosion-resistant metal construction. The foot switches for the directionals shall be momentary type, and the high beam shall be latching type. The spacing of the switches shall be such that inadvertent simultaneous deflection of switches is prevented.
Driver’s Amenities

Coat Hanger

Coat Hook
A hook and loop shall be provided to secure the driver’s coat.

Drink Holder
No drink holder.

Storage Box

Storage Box
An enclosed driver storage area shall be provided with a positive latching door and no lock. The minimum size is 2750 cubic in. An Agency approved trash can holder shall be provided. An Agency approved transfer collection container will be provided.

Windshield Wipers and Washers

Windshield Wipers
The bus shall be equipped with a windshield wiper for each half of the windshield. Bosch electric wipers or Deviation At 60 mph, no more than 10 percent of the wiped area shall be lost due to windshield wiper lift. For two-piece windshields, both wipers shall park along the center edges of the windshield glass. For single-piece windshields, wipers shall park along the bottom edge of the windshield. Windshield wiper motors and mechanisms shall be easily accessible for repairs or service. The fastener that secures the wiper arm to the drive mechanism shall be corrosion-resistant.

The windshield wiper shall be a single-control, electric two-speed intermittent wiper. A variable-speed feature shall be provided to allow adjustment of wiper speed for each side of the windshield between approximately five (5) and twenty-five (25) cycles per minute.

Windshield Washers
The windshield washer system, when used with the wipers, shall deposit washing fluid evenly and completely wet the entire wiped area.

The windshield washer system shall have a minimum 3-gallon reservoir, located for easy refilling from outside of the bus, and protected from freezing by the defroster or bus heating system. Reservoir pumps, lines and fittings shall be corrosion-resistant and must include a means to determine fluid level.
Driver’s Seat

FIGURE 6
Driver’s Seat

Dimensions

The operator's seat shall be a Recaro AM384 or Deviation, comfortable, and adjustable so that people ranging in size from a 95th-percentile male to a 5th-percentile female may operate the bus. While seated, the operator shall be able to make all of these adjustments by hand without complexity, excessive effort, or being pinched. Adjustment mechanisms shall hold the adjustments and shall not be subject to inadvertent changes. Graphical Symbols shall conform to SAE Recommended Practice (Proposed) J1458, Universal Symbols for Seat and Suspension Adjustments.

Seat Pan Cushion Length

Measurement shall be from the front edge of the seat pan to the rear at its intersection with the seat back. The adjustment of the seat pan length shall be no less than 16.5 in. at its minimum length and no more than 20.5 in. at its maximum length.

Seat Pan Cushion Height

Dimensions

Measurement shall be from the cab floor to the top of the level seat at its center midpoint. The seat shall adjust in height from a minimum of 14 in., with a minimum 6 in. vertical range of adjustment.

Seat Pan Cushion Slope

Measurement is the slope of the plane created by connecting the two high points of the seat, one at the rear of the seat at its intersection with the seat back and the other at the front of the seat just before it waterfalls downward at the edge. The slope can be measured using an inclinometer and shall be stated in degrees of incline relative to the horizontal plane (0 degrees). The seat pan shall adjust in its slope from no less than plus 12 degrees (rearward “bucket seat” incline), to no less than minus 5 degrees (forward slope).
**Seat Base Fore/Aft Adjustment**
Measurement is the horizontal distance from the heel point to the front edge of the seat. The minimum and maximum distances shall be measured from the front edge of the seat when it is adjusted to its minimum seat pan depth (approximately 15 in.). On all low-floor buses, the seat-base shall travel horizontally a minimum of 9 in. It shall adjust no closer to the heel point than 6 in. On all high-floor buses, the seat base shall travel a minimum of 9 in. and adjust no closer to the heel-point than 6 in.

**Seat Pan Cushion Width**
Measurement is the horizontal distance across the seat cushion. The seat pan cushion shall be 17 to 21 in. across at the front edge of the seat cushion and 20 to 23 in. across at the side bolsters. Rubber snubbers shall be provided to prevent metal-to-metal contact.

**Seat Suspension**
The operator’s seat shall be appropriately dampened with dual shocks and one shock must be adjustable. Suspension must be able to support a 100-550 lb. Driver.

**Seat Back**
**Width**
Measurement is the distance between the outermost points of the front of the seat back, at or near its midpoint in height. The seat back width shall be no less than 19 in. Seat back will include dual recliner gears on both sides of the seat.

**Height**
Standard height seat back.

**Headrests**
Adjustable headrest.

**Seat Back Lumbar Support**
Measurement is from the bottom of the seat back at its intersection with the seat pan to the top of the lumbar cushioning. The seat back shall provide adjustable depth lumbar back support with three individual operating lumbar cells within a minimum range of 7 to 11 in.

**Seat Back Angle Adjustment**
The seat back angle shall be measured relative to a level seat pan, where 90 degrees is the upright position and 90 degrees-plus represents the amount of recline.

The seat back shall adjust in angle from a minimum of no more than 90 degrees (upright) to at least 105 degrees (reclined), with infinite adjustment in between.

**Seat Belt**
The belt assembly should be an auto-locking retractor (ALR). All seat belts should be stored in automatic retractors. The belts shall be mounted to the seat frame so that the driver may adjust the seat without resetting the seat belt.

The seat and seat belt assemblies as installed in the bus shall withstand static horizontal forces as required in FMVSS 207 and 210.

Seatbelt and Shoulder belt webbing shall be orange in color.
Lap and Shoulder (Three-Point) Seat Belt
Seat belts shall be provided across the driver’s lap and diagonally across the driver’s chest. The driver shall be able to use both belts by connecting a single buckle on the right side of the seat cushion. 3-pt seatbelts must be emergency locking retractor (ELR) in design.

Adjustable-height D-ring.

All seatbelt assemblies shall come equipped with a warning switch device to remind operators to buckle up.

Lap Belt Length
The lap belt assembly shall be a minimum of 80 in. in length.

Adjustable Armrest
No armrests.

Seat Control Locations
While seated, the driver shall be able to make seat adjustments by hand without complexity, excessive effort or being pinched. Adjustment mechanisms shall hold the adjustments and shall not be subject to inadvertent changes.

Seat Structure and Materials
The operator's seat shall be contoured to provide maximum comfort for extended period of time. Cushions shall be fully padded with at least 3 inches of closed-cell foam or material with equal properties, in the seating areas at the bottom and back. The seat shall be upholstered with Black fresh per4mance fabric with integrated anti-bacterial qualities. Fabric shall have a Crypton water/oil repellant, antimicrobial, and antibacterial finish. All visually exposed metal on the operator's seat, including the pedestal, shall be powder-coated steel.

At the request of the Procuring Agency, the Contractor shall provide a certified test report fully documenting compliance with all the requirements defined above upon request. The test report shall contain a record of all testing activities, test diagrams, testing equipment, as well as test data related to loads, deflections and permanent deformation of the seat assembly. The report shall include a statement of compliance with the requirements of this section of Part 5: Technical Specifications.

Additional Requirements:
- Seat must include a 2-year parts and labor warranty, 5 year structural warranty
- Seat back must have dual recliner gears for added support.
- Seat back must include a stamped steel back to fully support the foam
- Seat must include a quick release riser that one mechanic can remove in 5-minutes.
- Seat must include a 4-way adjustable headrest
- Seat back must be protected with a full seat back protector

The seat shall withstand 10,000 impacts of a forty (40) pound sandbag dropped from a height of twelve (12) inches without visible deterioration. The seat shall be tested in the lowest vertical position and repeated with the seat in the top vertical position. A forty (40) pound sandbag shall be suspended on a thirty-six (36) inch pendulum and shall strike the seat back 10,000 times from distances of six (6), eight (8), ten (10), and twelve (12) inches. Seat cushion shall withstand 100,000 randomly positioned 1-1/2-inch drops of a squirming, 150 pound, smooth-surfaced buttocks-shape striker with only minimal wear on the seat covering.

Cushion Materials
Closed-cell polyurethane (FMVSS 302).
Pedestal
Stainless steel.

Seat Options
Seat Alarm
The bus horn shall sound when the driver is out of the seat and PP1 valve is not set (master switch on or off).

Seat Cushion Alarm Audio: In Addition To The Standard Audible Interior
Alarms, Provide Programming To Include The Vehicles Exterior Horns
When The Seat Is Unoccupied, & The Parking Brake Not Set.

Mirrors
Exterior Mirrors
The bus shall be equipped with a corrosion-resistant, outside rearview mirrors mounted with stable supports to minimize vibration. Mirrors shall be firmly attached to the bus to minimize vibration and to prevent loss of adjustment with a breakaway mounting system. Mirrors shall permit the driver to view the roadway along the sides of the bus, including the rear wheels. Mirrors should be positioned to prevent blind spots.

Mirrors shall retract or fold sufficiently to allow bus washing operations but avoid contact with windshield. A weatherproof Deutsch electrical connector, or Deviation shall be provided on the exterior of the bus, which enables the quick replacement of a damaged mirror.

Flat Mirrors on Both Sides
The bus shall be equipped with two flat outside mirrors, each with not less than 50 sq in. of reflective surface. The mirrors shall be located so as to provide the driver a view to the rear along both sides of the bus and shall be adjustable both in the horizontal and vertical directions to view the rearward scene. The roadside rearview mirror shall be positioned so that the driver’s line of sight is not obstructed.

Combination of flat and convex mirrors referred to as transit-specific.

The curbside and street side rearview mirror shall be mounted so that its lower edge is no less than 76 in. above the street surface. A lower mount may be required due to requested mirror configuration requests.

Heated and Remote Mirrors
The heaters shall be energized whenever the driver’s heater and/or defroster is activated, or can be activated independently.

The driver shall be able to adjust ALL the mirrors remotely while seated in the driving position. The control for remote positioning of the mirror shall be a single switch or device.

Interior Mirrors
Mirrors shall be provided for the driver to observe passengers throughout the bus without leaving the seat and without shoulder movement. The driver shall be able to observe passengers in the front/entrance and rear/exit areas with a full standee load, anywhere in the aisle, and in the rear seats. The suggested mirror arrangement is as follows:

a) Buses shall be equipped with two inside rear view mirrors.
   • Center rear view mirror above windshield shall be mounted on windshield header panel above and in front of driver. Dimensions shall be six (6) inches by thirty (30) inches. Mirror shall have a non-
reflective black rim and mounting bracket made of steel. Mirror shall be positively mounted to allow for adjustment but to eliminate, to the maximum practical extent, mirror vibration.

- Right windshield header mirror shall be a six (6) inch round mirror. This mirror shall be located so as not to interfere with passengers, and shall have an adjustable mounting bracket.
- A mirror shall be mounted above the entrance door. It shall be seven (7) inch by ten (10) inch and shall have an adjustable mounting bracket.

b) A twelve (12) inch diameter mirror shall be mounted above and behind the rear exit door in such a way that it will not interfere with passengers.

**WINDOWS**

**General**
All windows shall be Dura CityView or Deviation. The following minimum window area, including operator and door windows, shall be required on each side of the standard configuration bus:

<table>
<thead>
<tr>
<th>Bus Length (approximate)</th>
<th>Minimum Window Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 ft</td>
<td>6000 sq. in.</td>
</tr>
<tr>
<td>40 ft</td>
<td>10,000 sq. in.</td>
</tr>
<tr>
<td>60 ft</td>
<td>16,000 sq in</td>
</tr>
</tbody>
</table>

**Windshield**
The windshield shall permit an operator’s field of view as referenced in SAE Recommended Practice J1050. The vertically upward view shall be a minimum of 14 degrees, measured above the horizontal and excluding any shaded band. The vertically downward view shall permit detection of an object 3½ ft high no more than 2 ft in front of the bus. The horizontal view shall be a minimum of 90 degrees above the line of sight. Any binocular obscuration due to a center divider may be ignored when determining the 90-degree requirement, provided that the divider does not exceed a 3-degree angle in the operator’s field of view. Windshield pillars shall not exceed 10 degrees of binocular obscuration. The windshield shall be designed and installed to minimize external glare as well as reflections from inside the bus. When the bus is operated at night with the passenger interior lighting on, essentially no reflections shall be visible in the windshield immediately forward of the driver's barrier. Reflections in the remainder of the windshield shall be minimized. Reflection from block number sign lower right side of windshield will be eliminated.

The windshield shall be easily replaceable by removing zip-locks from the windshield retaining moldings. Bonded-in-place windshields shall not be used. Winglets may be bonded. The contractor shall provide a jig or fixture to assist in removing and replacing the windshield.

**Glazing**
The windshield glazing material shall have a ¼ in. nominal thickness laminated safety glass conforming to the requirements of ANSI Z26.1 Test Grouping 1A and the Recommended Practices defined in SAE J673.
Shaded Band
The upper portion of the windshield above the driver’s field of view shall have a dark, shaded band with a minimum luminous transmittance of 5 percent when tested in accordance to ASTM D-1003.

Driver’s Side Window
The driver’s side window shall be the sliding type with no latch, and shall open sufficiently to permit the seated operator to easily adjust the street-side outside rearview mirror. When in an open position, the window shall not rattle or close during braking. This window section shall slide in tracks or channels designed to last the service life of the bus. The sash frame lower rail shall be designed to drain water, due to condensation, to the exterior bus. The operator’s side window shall not be bonded in place and shall be easily replaceable. The glazing material shall have a single-density tint.

The driver’s view, perpendicular through operator’s side window glazing, should extend a minimum of 33 in. (840 mm) to the rear of the heel point on the accelerator, and in any case must accommodate a 95th percentile male operator. The view through the glazing at the front of the assembly should begin not more than 26 in. (560 mm) above the operator’s floor to ensure visibility of an under-mounted convex mirror. Driver’s window construction shall maximize ability for full opening of the window.

The driver’s side window glazing material shall have a ¼ in. nominal thickness laminated safety glass conforming with the requirements of ANSI Z26.1-1996 Test Grouping 2 and the Recommended Practices defined in SAE J673.

The design shall prevent sections from freezing closed in the winter. Light transmittance shall be 75 percent on the glass area below 53 in. from the operator platform floor. On the top fixed over bottom slider configuration, the top fixed area above 53 in. may have a maximum 5 percent light transmittance.

Standard Driver’s Side Window, Traditional Frame
- full slider
- non-egress

Quick Change Operator’s Side Window
Glazing in the window assembly shall be replaced without removing the window from its installed position on the bus or manipulation of the rubber molding surrounding the glazing. The glazing shall be held in place mechanically by a formed metal extruded ring constructed to last the life of the vehicle.

Side Windows
Configuration
Side windows shall not be bonded in place, but shall be easily replaceable without disturbing adjacent windows and shall be mounted so that flexing or vibration from engine operation or normal road excitation is not apparent. All aluminum and steel material will be treated to prevent corrosion.

All passenger windows shall be manufactured by Dura or Deviation. Windows shall have black anodized aluminum frames. All windows shall be three-quarter (¾) lower egress and all windows of the same size shall be interchangeable. All egress handles shall be located towards the front of the bus. Windows shall be designed to prevent the entrance of air and water when windows are closed. Near each window there shall be instructions on decals or aluminum plates that sufficiently explain emergency exit procedures. Location of the metal decal shall be determined by the Agency. Emergency instructions shall be printed in both English and Spanish. All requirements of FMVSS217 shall be complied with.
Side windows shall extend from the shoulder height of the 5th-percentile, seated, female passenger to the eye level of the 95th-percentile, standing male passenger. Vertical mullions between windows including the trim shall not exceed seven (7) inches in width. The side windows shall be fixed with the top portion of the “tip in” style to allow adequate ventilation of the coach, and meet the emergency escape requirements of FMVSS-217. The side window assemblies shall be identical, as far as practical, throughout the coach. Window assemblies that open must be aligned to preclude water leakage and excessive wind noise into the coach. The “tip in” windows shall be hinged with positively retained props or restraints to prevent accidental opening or opening beyond design limit. All side windows shall be easily replaceable without disturbing adjacent windows and shall be mounted so that flexing or vibration from engine operation or normal road excitation is not apparent.

Adequate clearance shall be provided between the seat backs and the window frames to allow quick access to the emergency egress latches, which shall be red in color.

Windows shall be one-quarter inch (1/4) tempered safety glass GY-2094, conforming to FMVSS 205 and applicable requirements of ANSI Z26.1. Tempered glass shall be able to withstand scratching by rotating brush washers. Tempered Glazing shall not craze due to solar rays or cold temperatures. Glazing color shall be consistent from window to window with the exception of the upper destination sign window. Upper destination sign’s window shall be clear in color. Maximum solar energy transmittance shall be forty-four (44) percent gray as measured by ASTME-424.

All passenger window one-quarter inch (1/4") tempered fixed glazing shall be protected by an acrylic liner. The acrylic liner shall be clear in color, one-sixteenth inch (1/16") or one-eighth inch (1/18") in thickness.

a) The acrylic shall be removable by Agency mechanics using simple hand tools.

b) Design must be simple where the worker can remove and replace the liner in less than one (1) minute.

c) The liner must be replaced without removing the window from its installed position on the bus, without removing the tempered glazing from the sash, and without the removal or manipulation of the window’s rubber molding.

d) Removal and replacement of the liner shall not require the removal or the modification or any other parts or fasteners.

Eight (8) hours of training showing Agency personnel how to perform initial installation of the window assemblies and any techniques for removal and replacement of tempered or acrylic glazing. Contractor shall further supply up to four (4) hours of training for service workers on how to most efficiently remove and replace the sacrificial liners.

All window assemblies shall be warranted covering the integrity and deterioration of the glazing for a period of two (2) years in Agency normal service. This warranty shall cover all material, labor, and workmanship. “Normal service” excludes accidents, vandalism, and improper maintenance or installation.

**Emergency Exit (Egress) Configuration**

**Minimum Egress**

All side windows shall be fixed in position, except as necessary to meet the emergency escape requirements.

**Standard Passenger Side Window Configurations**

- hidden frame (flush “Euro-look”)
- Commuter Coach: full fixed
- All other buses: openable windows with inward-opening transom panels.
Quick Change Passenger Side Windows
Glazing in the window assembly shall be replaced without removing the window from its installed position on the bus or manipulation of the rubber molding surrounding the glazing. The glazing shall be held in place mechanically by a formed metal extruded ring constructed to last the life of the vehicle.

Configuration
Operable Windows with Inward-Opening Transom Panels (Fixed Bottom, Tip-In Top)
Each operable side window shall incorporate an upper transom portion. The transom shall be between 25 and 35 percent of the total window area. The lower portion of the window shall be fixed. The transom portion shall be hinged along the lower edge, open inward, and latch in the fully closed position.

Fixed Side Windows (Commuter Coach)
All side windows shall be fixed in position, except as necessary to meet the emergency escape requirements.

Materials
Safety Glass Glazing Panels
Side windows glazing material shall be Heat Guard solar management or Deviation and shall have a minimum of 3/16 in. nominal thickness tempered safety glass. The material shall conform to the requirements of ANSI Z26.1-1996 Test Grouping 2 and the Recommended Practices defined in SAE J673.

Windows on the bus sides and in the rear door shall be tinted a neutral color, complementary to the bus exterior. The maximum solar energy transmittance shall not exceed 37 percent, as measured by ASTM E-424. Luminous transmittance shall be measured by ASTM D-1003. Windows over the destination signs shall not be tinted.

Rear Window
No requirement for rear window.

HEATING, VENTILATING AND AIR CONDITIONING
Capacity and Performance
The HVAC climate control system shall be capable of controlling the temperature and maintaining the humidity levels of the interior of the bus as defined in the following paragraphs.

HYBRID BUSES
Fully AC high-voltage electric-driven A/C system with full / semi- hermetic AC compressor, condenser fan and evaporator blower motors.

Allow Either Roof- or Rear-Mounted HVAC Unit
The HVAC unit may either be roof or rear-mounted.

Capacity and Performance Requirements
The air-conditioning portion of the HVAC system shall be capable of reducing the passenger compartment temperature from 110 to 90 °F in less than 20 minutes after engine start-up. Engine temperature shall be within the normal operating range at the time of start-up of the cool-down test, and the engine speed shall be limited to fast idle, which may be activated by a driver-controlled device. During the cool-down period, the refrigerant pressure shall not exceed safe high-side pressures, and the condenser discharge air temperature, measured 6 in. from the surface of the coil, shall be less than 45 °F above the condenser inlet air temperature. The appropriate
solar load as recommended in the APTA “Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System,” representing 4 p.m. on August 21, shall be used. There shall be no passengers on board, and the doors and windows shall be closed.

With the bus running at the design operating profile with corresponding door opening cycle, and carrying a number of passengers equal to 150 percent of the seated load, the HVAC system shall control the average passenger compartment temperature within a range between 65 and 80 °F, while maintaining the relative humidity to a value of 50 percent or less. The system shall maintain these conditions while subjected to any outside ambient temperatures within a range of 10 to 95 °F and at any ambient relative humidity levels between 5 and 50 percent.

When the bus is operated in outside ambient temperatures of 95 to 115 °F, the interior temperature of the bus shall be permitted to rise 0.5° for each degree of exterior temperature in excess of 95 °F.

When bus is operated in outside ambient temperatures in the range of -10 to 10 °F, the interior temperature of the bus shall not fall below 55 °F while the bus is running on the design operating profile.

System capacity testing, including pull-down/warm-up, stabilization and profile, shall be conducted in accordance to the APTA’s “Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System.”

R134a
The air conditioning system shall meet these performance requirements using R134a.

Controls and Temperature Uniformity
The HVAC system excluding the driver’s heater/defroster shall be centrally controlled with an advanced electronic/diagnostic control system with provisions for extracting/reading data. The system shall be compliant with J1939 Communication Protocol for receiving and broadcasting of data. The system shall provide two way communication with live diagnostics and notifications.

Hot engine coolant water shall be delivered to the HVAC system driver’s defroster/heater and other heater cores by means of an auxiliary coolant marine pump, sized for the required flow, which is brushless and sealless having a minimum maintenance free service life for both the brushless motor and the pump of at least 40,000 hours at full power. The pump shall be a magnetic drive type. Isolation of the pump for service shall be with one-quarter (1/4) turn valves.

Manual Mode Selection of Climate Control System
After manual selection and/or activation of climate control system operation mode, all interior climate control system requirements for the selected mode shall be attained automatically to within ±2 °F of specified temperature control set-point.

- The heating, ventilation and air conditioning (HVAC) climate control system shall be Thermo King or Deviation and capable of maintaining the interior of the bus at the temperature and humidity levels defined in the following paragraphs. The HVAC system shall be a unitized Thermo-King or Agency approved equivalent system mounted on the rear attic area of the bus. A complete HVAC capacity and performance analysis shall demonstrate compliance with all performance requirements. TK HVAC system shall utilize a X430 Compressor. The agency would like an option quote on ALL ELECTRIC T.K. AND SUTRAK HVAC ON ALL FLEET TYPES.

Air Flow
Passenger Area

Requirement for 10 percent “Fresh Air” Mixture
The air shall be composed of no less than 10 percent outside air.

Driver’s Area
The bus interior climate control system shall deliver at least 100 cfm of air to the driver’s area when operating in the ventilating and cooling modes. Adjustable nozzles shall permit variable distribution or shutdown of the airflow. Airflow in the heating mode shall be reduced proportionally to the reduction of airflow into the passenger area. The windshield defroster unit shall meet the requirements of SAE Recommended Practice J382, “Windshield Defrosting Systems Performance Requirements,” and shall have the capability of diverting heated air to the driver’s feet and legs. The defroster or interior climate control system shall maintain visibility through the driver’s side window. Please provide cost for additional AC focused in the operators area.

The operator shall be provided independent control of the defroster and operators heater. The controls shall include:

- **MODE** Heat or defrost.
- **TEMP** Air outlet temperature.
- **FAN** Airflow fan speed control.

Controls for the Climate Control System (CCS)
The controls for the driver’s compartment for heating, ventilation and cooling systems shall be integrated and shall meet the following requirements:

- The heat/defrost system fan shall be controlled by a separate switch that has an “off” position and at least two positions for speed control. All switches and controls shall preclude the possibility of clothing becoming entangled, and shields shall be provided, if required. If the fans are approved by the Agency, an “on-off” switch shall be located to the right of or near the main defroster switch.
- A electrically operated control valve shall control the coolant flow through the heater core.
- Electric Heater water control valves shall be “positive” type, closed or open. The method of operating remote valves shall require the concurrence of the Agency project manager.

Driver’s Compartment Requirements
A separate heating, ventilation and defroster system for the driver’s area shall be provided and shall be controlled by the driver. The system shall meet the following requirements:

- The heater and defroster system shall provide heating for the driver and heated air to completely defrost and defog the windshield, driver’s side window, and the front door glasses in all operating conditions. Fan(s) shall be able to draw air from the bus body interior and/or the exterior through a control device and pass it through the heater core to the defroster system and over the driver’s feet. A minimum capacity of 100 cfm shall be provided. The driver shall have complete control of the heat and fresh airflow for the driver’s area.
- The defroster supply outlets shall be located at the lower edge of the windshield. These outlets shall be durable and shall be free of sharp edges that can catch clothes during normal daily cleaning. The system shall be such that foreign objects such as coins or tickets cannot fall into the defroster air outlets. Adjustable ball vents or louvers shall be provided at the left of the driver’s position to allow direction of air onto the side windows.
A ventilation system shall be provided to ensure driver comfort and shall be capable of providing fresh air in both the foot and head areas. Vents shall be controllable by the driver from the normal driving position. Decals shall be provided, indicating “operating instructions” and “open” and “closed” positions. When closed, vents shall be sealed to prevent the migration of water or air into the bus.

**Driver’s Cooling**
A separate, dedicated evaporator is not required for the driver’s compartment.

A separate fan unit shall provide 100 cfm of air to the driver’s area through directionally adjustable nozzles and an infinitely variable fan control, both of which shall be located above and ahead of the driver.

Air from the evaporator shall be provided to the driver’s area through vents located on the dash in front of the driver.

**Air Filtration**
Outside openings for air intake shall be located to ensure cleanliness of air entering the climate control system, particularly with respect to exhaust emissions from the bus and adjacent traffic. All intake openings shall be baffled to prevent entry of snow, sleet, or water.

Air shall be filtered before discharge into the passenger compartment. The filter shall meet the ANSI/ASHRAE 52.1 requirement for 5 percent or better atmospheric dust spot efficiency, 50 percent weight arrestance, and a minimum dust holding capacity of 120 g per 1000 cfm cell. Air filters shall be easily removable for service. More efficient air filtration may be provided to maintain efficient heater and/or evaporator operation. Moisture drains from air intake openings shall be located to prevent clogging from road dirt.

**Disposable Type Filters**
Air filters shall be of disposable type.

**Roof Ventilators**

**One Roof Ventilator**
One ventilator shall be provided in the roof of the bus.

The ventilator shall be easily opened and closed manually. When open with the bus in motion, this ventilator shall provide fresh air inside the bus. The ventilator shall cover an opening area no less than 425 sq in. and shall be capable of being positioned as a scoop with either the leading or trailing edge open no less than 4 in., or with all four edges raised simultaneously to a height of no less than 3½ in. An escape hatch shall be incorporated into the roof ventilator. Roof ventilator(s) shall be sealed to prevent entry of water when closed.

**Maintainability**
Manually controlled shut-off valves in the refrigerant lines shall allow isolation of the compressor and dehydrator filter for service. To the extent practicable, self-sealing couplings utilizing O-ring seals shall be used to break and seal the refrigerant lines during removal of major components, such as the refrigerant compressor. Shut-off valves may be provided in lieu of self-sealing couplings. The condenser shall be located to efficiently transfer heat to the atmosphere and shall not ingest air warmed above the ambient temperature by the bus mechanical equipment, or to discharge air into any other system of the bus. The location of the condenser shall preclude its obstruction by wheel splash, road dirt or debris. HVAC components located within 6 in. of floor level shall be constructed to resist damage and corrosion.
**Entrance/exit area heating**
No requirements for entrance/exit area heating.

**Floor-Level Heating**
No requirements for floor-level heating.

**EXTERIOR PANELS, FINISHES AND EXTERIOR LIGHTING**

**Design**
This bus shall have a clean, smooth, simple, non-BRT design. The exterior and body features, including grilles and louvers, shall be shaped to facilitate cleaning by automatic bus washers without snagging washer brushes. Water and dirt shall not be retained in or on any body feature to freeze or bleed out onto the bus after leaving the washer. The body and windows shall be sealed to prevent leaking of air, dust or water under normal operating conditions and during cleaning in automatic bus washers for the service life of the bus.

Only exterior panels that are above the rub-rail may be structural components. Exterior surface panels shall not be installed or retained with visible rivets or fasteners. All exterior side panels shall be essentially flat, without ripples and with minimal visible joints. Exterior panels shall be sufficiently stiff to minimize vibration, drumming or flexing while the bus is in service. When panels are lapped, the upper and forward panels shall act as a watershed. However, if entry of moisture into the interior of the vehicle is prevented by other means, then rear cap panels may be lapped otherwise. The windows, hatches and doors shall be able to be sealed. Accumulation of spray and splash generated by the bus’s wheels shall be minimized on windows and mirrors.

Side panels below the window line shall be aluminum, etched, primed and painted to Agency paint scheme.

**Materials**
Body materials shall be selected and the body fabricated to reduce maintenance, extend durability and provide consistency of appearance throughout the service life of the bus. Detailing shall be kept simple, and add-on devices and trim shall be minimized and integrated into the basic design.

No requirement for protection against graffiti/vandalism for body material surfaces.

**Roof-Mounted Equipment**
A non-skid, clearly marked walkway or steps shall be incorporated on the roof to provide access to equipment without damaging any system or bus paneling.

**Pedestrian Safety**
The exterior rearview mirrors, cameras and required lights and reflectors are exempt from the protrusion requirement. Advertising frames shall protrude no more than ⅞ in. from the body surface. Grilles, doors, bumpers and other features on the sides and rear of the bus shall be designed to minimize toeholds or handholds.

Exterior protrusions shall not cause a line-of-sight blockage for the driver.

**Repair and Replacement**

**Side Body Panels**
Structural elements supporting exterior body panels shall allow side body panels below the windows to be repaired in lengths not greater than 12.5 ft.
Welding, riveting, or adhesive attachment is deemed unacceptable, although adhesive, as a secondary method to control panel resonance will be permitted.

Side panels shall be simple enough in shape to allow fabrication with no more tooling than a shear, brake, and edge roller. Metal panels with compound curves, fluting, curved indentations, etc. will not be permitted.

**Easily Replaceable Side Body Panels**

Exterior panels below the rub-rail shall be divided into sections that are repairable or replaceable by 3M mechanic in less than thirty (30) minutes for a section up to five feet long (excludes painting).

Exterior side panels above the rub-rail and below the lower daylight opening shall be repairable or replaceable by a 3M mechanic in less than 1-1/2 hours for a section up to five (5) feet long (excludes painting).

**Rain Gutters**

Rain gutters shall be provided to prevent water flowing from the roof onto the passenger doors and driver’s side window. When the bus is decelerated, the gutters shall not drain onto the windshield, driver’s side window or door boarding area. Cross-sections of the gutters shall be adequate for proper operation.

**License Plate Provisions**

Corrosion resistant provisions shall be made to securely mount standard size U.S. license plates on a bracket which is mounted to the front and rear of the bus using all four holes in the license plates. These provisions shall flush mount or recess the license plates so that they can be cleaned by automatic bus washing equipment without being caught by the brushes. License plates shall be mounted on the streetside or center of the bus and shall not allow a toehold or handhold for unauthorized riders. Do not supply a tag cover.

**Rub rails**

No requirement for rub rails.

**Fender Skirts**

Features to minimize water spray from the bus in wet conditions shall be included in wheel housing design. Any fender skirts shall be easily replaceable. They shall be flexible if they extend beyond the allowable body width. Wheels and tires shall be removable with the fender skirts in place.

(Reserved)

**Splash Aprons**

**Standard Splash Aprons**

Splash aprons, composed of ¼ in. minimum composition or rubberized fabric, shall be installed behind and/or in front of wheels as needed to reduce road splash and protect underfloor components. The splash aprons shall extend downward to within 6 in. off the road surface at static conditions. Front apron widths shall be no less than tire widths; rear aprons shall be full width. Splash aprons shall be bolted to the bus understructure. Splash aprons and their attachments shall be inherently weaker than the structure to which they are attached. The flexible portions of the splash aprons shall not be included in the road clearance measurements. Splash apron shall be installed as necessary to protect the wheelchair loading device from road splash. Other splash aprons shall be installed where necessary to protect bus equipment.
Service Compartments and Access Doors

Access Doors
Conventional or pantograph hinged doors shall be used for the engine compartment and for all auxiliary equipment compartments including doors for checking the quantity and adding to the engine coolant, engine lubricant and transmission fluid. Access openings shall be sized for easy performance of tasks within the compartment, including tool operating space. Access doors shall be of rugged construction and shall maintain mechanical integrity and function under normal operations throughout the service life of the bus. They shall close flush with the body surface. All doors shall be hinged at the top or on the forward edge and shall be prevented from coming loose or opening during transit service or in bus washing operations. All access doors shall be retained in the open position by props or counterbalancing with over-center or gas-filled springs with safety props and shall be easily operable by one person. Springs and hinges shall be corrosion resistant. Latch handles shall be flush with, or recessed behind, the body contour and shall be sized to provide an adequate grip for opening. Access doors, when opened, shall not restrict access for servicing other components or systems. Major access doors shall be equipped with locks requiring a nominal 5/16-inch, square end tool to open. The locks shall be standardized so that only one tool is required to open all major access doors on the bus.

If precluded by design, the manufacturer shall provide door design information specifying how the requirements are met.

Access Door Latch/Locks

Requirement for Latches on Access Doors
Access doors larger than 100 sq in. in area shall be equipped with corrosion-resistant flush-mounted latches or locks except for coolant and fuel fill access doors. All such access doors that require a tool to open shall be standardized throughout the vehicle and will require a nominal 5/16 in. square male tool to open or lock.

Bumpers

Location
Bumpers shall provide impact protection for the front and rear of the bus with the top of the bumper being 27 in., ± 2 in., above the ground. Bumper height shall be such that when one bus is parked behind another, a portion of the bumper faces will contact each other. The bumpers shall wrap around the bus to the extent practical without exceeding allowable bus width.

Front Bumper
No part of the bus, including the bumper, shall be damaged as a result of a 5 mph impact of the bus at curb weight with a fixed, flat barrier perpendicular to the bus’s longitudinal centerline. The bumper shall return to its pre-impact shape within 10 minutes of the impact. The bumper shall protect the bus from damage as a result of 6.5 mph impacts at any point by the common carriage with contoured impact surface defined in Figure 2 of FMVSS 301 loaded to 4000 lbs parallel to the longitudinal centerline of the bus. It shall protect the bus from damage as a result of 5.5 mph impacts into the corners at a 30-degree angle to the longitudinal centerline of the bus. The energy absorption system of the bumper shall be independent of every power system of the bus and shall not require service or maintenance in normal operation during the service life of the bus. The bumper may increase the overall bus length specified by no more than 7 in.

The bumper shall have mounting provisions for integrated quick-release bike rack, Sportworks or Deviation

Rear Bumper
No part of the bus, including the bumper, shall be damaged as a result of a 2 mph impact with a fixed, flat barrier perpendicular to the longitudinal centerline of the bus. The bumper shall return to its pre-impact shape within 10
minutes of the impact. When using a yard tug with a smooth, flat plate bumper 2 ft wide contacting the horizontal centerline of the rear bumper, the bumper shall provide protection at speeds up to 5 mph, over pavement discontinuities up to 1 in. high, and at accelerations up to 2 mph/sec. The rear bumper shall protect the bus, when impacted anywhere along its width by the common carriage with contoured impact surface defined in Figure 2 of FMVSS 301 loaded to 4000 lbs, at 4 mph parallel to or up to a 30-degree angle to, the longitudinal centerline of the bus. The rear bumper shall be shaped to preclude unauthorized riders standing on the bumper. The bumper shall not require service or maintenance in normal operation during the service life of the bus. The bumper may increase the overall bus length specified by no more than 7 in.

**Bumper Material**

Bumper material shall be corrosion-resistant and withstand repeated impacts of the specified loads without sustaining damage. Visible surfaces shall be black, color subject to approval at the pre-production meeting. These bumper qualities shall be sustained throughout the service life of the bus.

**Finish and Color**

**Appearance**

All exterior surfaces shall be smooth and free of visible fasteners, wrinkles, and dents. Areas where external fasteners may be required must be submitted to the Agency for approval in advance of the Pilot Bus. Exterior surfaces to be painted shall be properly cleaned and primed as appropriate for the paint used, prior to application of paint to assure a proper bond between the basic surface and successive coats of original paint for the service life of the bus. Paint with PPG Delfleet. FBCH Base Coat. PPG Delfleet 3930 Clear Coat. PPG Delfleet 3993/95/97 Sealer. PPG Delfleet 3993 Epoxy Primer. Proper adhesion between the basic surface and successive coats of the original paint shall be measured using a Cross Hatch Adhesion Test as outlined in ASTM D3359B. Adhesion testing must be completed on every 10th bus.

All paint shall be applied smoothly and evenly with the finished surface free of dirt, runs, orange peel, and other imperfections. All exterior finished surfaces shall be impervious to diesel fuel, gasoline, natural gas and commercial cleaning agents. Finished surfaces shall not be damaged by controlled applications of commonly used graffiti-removing chemicals.

The Contractor shall prepare a paint coating and application document containing procedures for surface cleaning and preparation, priming, surfacing, and painting for the bus body and all equipment that is painted or powder coated. A detailed paint schedule showing the equipment painted, paint type and manufacturers, recommended thickness, and other pertinent information shall also be included. This document shall be submitted for review at the pre-production meeting and shall be part of the maintenance manuals.

Any equipment or parts of equipment which would be damaged or suffer impaired operation from painting shall not be painted and shall be corrosion-resistant. Excluding original manufacturer painting the following items shall not be painted:

a) Wire and cable  
b) Heat transfer surfaces  
c) Electrical insulators  
d) Elastomeric portions of air and refrigerant lines  
e) Grounding pads
Colors and paint scheme shall be generally in accordance with Agency Drawings to be provided. Three color accent stripes will provided around the exterior of the bus. The Agency is requiring the Contractor to match the colors and locations of stripes on their existing vehicles. The striping specifications will be issued by the Agency upon issuance of the contract. Decals will not be acceptable for exterior striping.

Within sixty (60) days of NTP, the Contractor shall supply body outline drawings of the exterior of the bus with three optional paint schemes and all markings for Agency review, selection and approval. Bids shall be based on a four color paint scheme. Final approval of the color scheme will be determined at the pre-production meeting.

**High Gloss External Paint Finish Quality**
Painted surfaces shall have a minimum 95 gloss and an orange peel rating of 7 or more on the Advanced Coating Technologies, Inc., orange peel standard panels set #APR 14941 or Agency accepted wave scan equipment. Paint shall last a minimum of six years with a minimum gloss of 90 as measured in ASTM E97-92, “Standard Test Method For Directional Reflectance.”

Basecoat/ClearCoat paint system.

**Decals, Numbering and Signing**
Unless otherwise specified or approved by the Agency, all interior lettering, numbering, labeling, etc. shall be clearly printed on 0.080-inch anodized aluminum plate by either of the following processes:

- Silk screen lettering covered with a clear protective finish.
- Photo–etching and epoxy paint.

The plates shall be mechanically fastened in a manner approved by the Agency. All text shall be Helvetica medium, all caps. Graphics shall be provided as follows:

- Bus numbers shall be provided in six inch numerals in eight locations as listed below in a sequence to be selected by the Agency. The location is to be approved by the Agency. The numbers shall be white on black or black on white or non-black.
  - Right front approximately four (4) inches below the windshield.
  - Right side above entry door.
  - Left side above the driver's window.
  - In the center (left to right) of the rear of the bus, five (5) feet above the pavement. Locations to be approved by the Agency.
  - Centered (L to R) on the panel above the windshield on the inside of the bus.
  - Left and right rear corners of the bus, centered in the white paint area below the belt line, approximately three (3) feet from the rear of the bus.
• Inside surface of engine door when open. Print so numbers will be right side up when door is open.
• On outside of engine belt guard

b) Bus numbers shall also be painted on the roof in the maximum size possible. The Agency prefers that the numbers be thirty (30) inches high. The number shall be vertical starting at the front of the bus.

c) A logo type design shall be applied to the bus exterior in areas to be selected by the Agency. Logo design shall be furnished by the Agency.

d) The bidder will not affix to the exterior or interior of the bus any logos or identification without the prior written permission of the Agency.

e) Additional Agency-approved graphics shall be provided for passenger and safety information.

f) At least one sign shall be provided on each side of the bus interior to indicate that seats at the front are priority seats for elderly and persons with disabilities.

g) The following decals shall be supplied, as a minimum:

<table>
<thead>
<tr>
<th>MESSAGE</th>
<th>LOCATION</th>
<th>COLOR*</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;No Smoking, Eating or Drinking or Radios&quot;, using universal symbols</td>
<td>Interior above windshield and rear bulkhead</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>(Operating Instructions), Starting, etc.</td>
<td>Interior above windshield</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>Caution Label, English and Spanish</td>
<td>Entrance door posts</td>
<td>White 2&quot;</td>
</tr>
<tr>
<td>Fire Extinguisher</td>
<td>Front Safety Compartment</td>
<td>White Mfg. Std.</td>
</tr>
<tr>
<td>&quot;Watch your step&quot;, English and Spanish</td>
<td>Front &amp; Rear stepwell</td>
<td>Red 2&quot; Reflective</td>
</tr>
<tr>
<td>(Operating Instructions), English and Spanish</td>
<td>Above exit door</td>
<td>Black Mfg. Std.</td>
</tr>
<tr>
<td>(Operating Instructions), English and Spanish</td>
<td>At emergency escapes</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>&quot;For passenger safety, Federal law prohibits operation of this bus while anyone is standing forward of the white line&quot;, English and Spanish</td>
<td>Interior above windshield</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>&quot;As a courtesy, please allow handicapped and elderly passengers to use these seats&quot;, English and Spanish</td>
<td>Above front longitudinal seats</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>“Wheelchair Seating Area. Securements are located below these seats.”, English and Spanish with wheelchair logo</td>
<td>Wheelchair seating areas</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>“Wheelchair Riders have priority in this area.”, English and Spanish with wheelchair logo</td>
<td>Wheelchair seating areas</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>&quot;Exit Door&quot;, English and Spanish</td>
<td>Above exit door</td>
<td>Red Mfg. Std.</td>
</tr>
<tr>
<td>&quot;Front Door Air Valve&quot;</td>
<td>Side console on valve</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>&quot;Ultra Low Diesel Fuel Only&quot;</td>
<td>Inside fuel filler door</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>“Windshield Washer Bottle Fill”</td>
<td>As appropriate</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>Welding Caution</td>
<td>As appropriate</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>“Shop Air Fill”</td>
<td>As appropriate</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>Radiator Fill Procedure</td>
<td>As appropriate</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------------</td>
<td>----------------</td>
<td>---------------</td>
</tr>
<tr>
<td>&quot;Oil&quot;</td>
<td>Inside oil filler door</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>&quot;Caution 'Water' Hot&quot;</td>
<td>Inside surge tank filler door</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>&quot;Caution – Negative Ground”</td>
<td>Inside battery compartment door</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>“Battery Disconnect”</td>
<td>Outside battery compartment door</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>“Battery Switch, On/Off”</td>
<td>Inside battery compartment door</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>“Authorized Personnel Only”</td>
<td>Electronic Locker</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>Fan Caution</td>
<td>Inside engine compartment</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>&quot;Exit through back door&quot;</td>
<td>Interior above windshield</td>
<td>Mfg. Std.</td>
</tr>
<tr>
<td>&quot;Wait for light&quot;, English and Spanish</td>
<td>Interior above rear door to right</td>
<td>Black Mfg. Std</td>
</tr>
<tr>
<td>&quot;Push door to open&quot;</td>
<td>2 locations-Interior on top panel of each door</td>
<td>Black Mfg. Std</td>
</tr>
<tr>
<td>Bus Numbers</td>
<td>8 locations: See Painting and Decals section on previous page</td>
<td>Black on White, or White on Black</td>
</tr>
</tbody>
</table>

**Passenger Information**

ADA priority seating signs as required and defined by 49 CFR, Part 38.27 shall be provided to identify the seats designated for passengers with disabilities.

Requirements for a public information system in accordance with 49 CFR, Part 38.35 shall be provided.

**Exterior Lighting**

All exterior lights shall conform to FMVSS requirements, be sealed to prevent entry and accumulation of moisture or dust, and each lamp shall be replaceable in less than five (5) minutes by a 2M mechanic. Light Emitting Diode (LED) lights shall be utilized for all applications where certified LED lights are available and shall be Dialight, or Deviation. LED lights shall be constructed with a single piece lens with the cavity seal accomplished via a potting process, a welded lens to housing construction is not allowed. All electrical connections to the LED light shall be by wire coming directly from the light housing and terminated with a Packard Weather Pak or equal connector. No interim connector shall be allowed on the body of the light. Exterior surfaces of light lenses shall be smooth to prevent dirt accumulation and ease the washing process. Lights mounted on the engine compartment doors shall be protected from the impact shock of door opening and closing. Lights mounted on the roof or upper sections of the bus shall have protective shields, be armored, or be flush mounted to protect the lens. LED’s shall be protected from chemical and abrasion degradation. Location of all exterior lighting will be approved during the pre-production meeting.

**Backup Light/Alarm**

Visible and audible warnings shall inform following vehicles or pedestrians of reverse operation. The reverse lights shall be four (4) inch round, white LEDs. Visible reverse operation warning shall conform to SAE Standard J593. Audible reverse operation warning shall conform to SAE Recommended Practice J994 Type C or D.
Doorway Lighting
Lamps at the front and rear passenger doorways shall comply with ADA requirements and shall activate only when the doors open. These lamps shall illuminate the street surface to a level of no less than 1 foot-candle for a distance of 3 ft outward from the outboard edge of the door threshold. The lights may be positioned above or below the lower daylight opening of the windows and shall be shielded to protect passengers’ eyes from glare.

Turn Signals

Standard Turn Signals
Turn-signal lights shall be provided on the front, rear, curb and street sides of the bus in accordance with FMVSS 108 and Part 393, Subpart B of the FMCSA as applicable.

Two (2) rear and two (2) front amber turn signals shall be mounted on the bus. The rear turn signals shall be in the top position. Turn signals shall include a current regulator circuit to the LEDs that allow constant light intensity with applied voltage ranging from seven (7) to sixteen (16) volts.

One (1) amber side turn signal lamp shall be provided on both the curbside and street side of the bus. The turn signals shall be guarded for protection, installed rearward of the front axle, as close to the axles as possible. Side turn signal lamps shall be visible from the front and rear as well as outward.

Headlights

Headlamps shall be guide lamp, rectangular sealed beam, LED. The high beam headlights shall be switched on with ignition switch as Daytime Running Lights using a DRL module. A dimmer switch shall be mounted on the floor between and above the turn signal switches. The instrument panel shall have a high beam indicator lamp.

Standard Installation
Standard OEM headlight installation shall be provided in accordance with FMVSS 108 and Part 393, Subpart B of the FMCSA as applicable.

Brake Lights

Brake lights shall be provided in accordance with FMVSS 108 and Part 393, Subpart B of the FMCSA as applicable.

No High/Center Mount Brake Lamp or Deceleration Warning Lamps
Bus shall not include a high/center mount brake lamp and/or deceleration warning indicator lamps.

Four, (4), four (4) -inch round, Brake LED lights shall be mounted at the rear of bus. Two (2) of the four (4) brake lights shall be mounted on the rear center of the bus, the remaining two (2) lights shall be mounted near the reverse and turn signal lights in the middle position. Mounting position shall be approved by the Agency. Brake lights shall include a current regulator circuit to the LEDs that allow constant light intensity with applied voltage ranging from seven (7) to sixteen (16) volts.

Service Area Lighting (Interior and Exterior)
LED lamps shall be provided in the engine and all other compartments where service may be required to generally illuminate the area for night emergency repairs or adjustments, producing a minimum of 300 lumens of light. These service areas shall include, but not be limited to, the engine compartment, the communication box, junction/apparatus panels and passenger door operator compartments. Lighting shall be adequate to light the space of the service areas to levels needed to complete typical emergency repairs and adjustments. The service area lamps shall be suitable for the environment in which they are mounted.
Engine compartment lamps shall be controlled by a switch mounted near the rear start controls. All other service area lamps shall be controlled by switches mounted on or convenient to the lamp assemblies. Power to the service area lighting shall be programmable. Power shall latch on with activation of the switch and shall be automatically discontinued (timed out) after 30 minutes to prevent damage caused by inadvertently leaving the service area lighting switch in the on position after repairs are made.

**Clearance Marker and I.D. Lights:**
All clearance marker and I.D. lights shall be flush mounted LED type with smooth lenses to prevent the collection of dirt and damage during washing.

**License Plate Light:**
The license plate light shall be LED and located in the right lower quadrant of the engine door.

### 3.1.1.1 Bicycle Racks

The Contractor shall mount a bicycle rack, Sportwork DL2, or Deviation, to the front bumper of the bus. The bike rack shall be installed as per the manufacturer’s recommendations and shall not impact the bus approach angle. The bike rack shall be mounted to preclude damage to the windshield in the event of a frontal impact. The Agency would prefer quick release bike rack mount.

Appropriate decals shall be installed at the front of the bus to adequately describing the operation of the bicycle rack. Decals and decal location shall be approved by the Agency during the Pilot Bus review.

The bicycle rack shall be designed to carry two bicycles. Each bike can be loaded/unloaded independently of the other.

In the deployed position the bike rack shall latch automatically in position. When not in use the bike rack shall fold upward against the front of the bus and latch securely in place.

The bike rack shall not interfere with the operation of the windshield wipers, access panels, or front lift tow or flat tow adapters. The bike rack shall be easily removable for seasonal and emergency detachment from the bus. Detachment shall not require removal or disassembly of the front bumper or any other bus mounted parts. Approval of the mounting location and installation will be provided by the Agency during the Pre Production meetings. Bus must be equipped with indicator light visible to the Operator which will be illuminated when the back rack is down.

### INTERIOR PANELS AND FINISHES

**General Requirements**

Interior panels may be integral with, or applied to, the basic bus structure. They shall be decorated in accordance with the interior specified. Use of moldings and small pieces of trim shall be minimized, and all parts shall be functional. Materials shall be selected on the basis of maintenance, durability, appearance, safety, flammability and tactile qualities. Materials shall be strong enough to resist everyday abuse and be vandalism and corrosion resistant. Trim and attachment details shall be kept simple and unobtrusive. Interior trim shall be secured to avoid resonant vibrations under normal operational conditions. Seating material shall be Holdsworth Defender or Deviation.

The interior shall be generally pleasing—simple, modern, and free from superficial design motifs. It shall have no sharp depressions or inaccessible areas and shall be easy to clean and maintain. Interior surfaces more than 10 in. below the lower edge of the side windows or windshield shall be shaped so that objects placed on them fall to the floor when the coach is parked on a level surface. The entire interior shall allow cleaning with a hose, using a liquid soap attachment. Water and soap should not normally be sprayed directly on the instrument and switch
panels. Any components and other electrical components within close proximity to these surfaces shall also be resistant to this cleaning method. There shall be no sharp, abrasive edges and surfaces and no unnecessary hazardous protuberances. All plastic and synthetic materials used inside the bus shall be fire-resistant, except vinyl seat coverings which shall meet the requirements of Federal Specification CCC-A-680 (a) Class II Treatment “A1” and seating upholstery textiles which shall meet the requirements for textiles in Federal Aviation Regulations 25.853(b), as tested in accordance with Appendix F of that part.

Interior trim shall be applied and mechanically fastened to supporting surfaces. The mounting shall be designed to accommodate the dynamics of vehicle movement without transmitting stress to trim panels. Interior trim shall be designed to have a minimum one-quarter (1/4) inch radius cove at intersecting adjacent surfaces. Floor trim shall be stainless steel material.

Sidewall posts between the windows shall be covered with a suitable material and must be approved by the Agency, in writing, prior to bid. Color shall be nonreflective black. The rear bulkhead and rear interior surfaces shall be material suitable for exterior skin, painted and finished to exterior quality, or paneled with melamine type material, plastic, and trimmed with stainless steel or aluminum. Colors shall be russet or coordinate with the balance of the bus interior.

“Anti-squeak” tape shall be used between interior trim panels and any structure. Where trim panels cover apparatus requiring replacement, or even infrequent maintenance, they shall be fastened with captive, tamperproof fasteners requiring the same tool as all other interior fasteners, designed to allow ready access for removal and replacement of apparatus. The design and layout of the interior trim shall minimize the size and number of seams and moldings. Panels and fasteners shall not be easily removable by passengers.

The walls shall have a graffiti resistance rating of one (1) as per Section 21 of the APTA Transit Security Guidelines Manual or by other appropriate materials as approved by the Agency. The ceiling shall have a rating of two (2) or better. All other interior surfaces shall have a low-glare finish with a glossometer reading between four (4) and fourteen (14), per ASTM D 523, machine direction, using a sixty (60) degree glossometer. Side and rear end time panels shall be one-eighth (1/8) inch thick, minimum.

Internal surfaces, as possible, to be stainless steel or other resistant material.

**Interior Panels**

Panels shall be easily replaceable and tamper-resistant. They shall be reinforced, as necessary, to resist vandalism and other rigors of transit bus service. Individual trim panels and parts shall be interchangeable to the extent practicable.

Interior side trim panels and driver's barrier shall be melamine, 0.12 inch thick minimum thickness, or other approved composite plastic trim panel material that meet Docket 90 requirements and are graffiti resistant. It shall permit easy removal of paint, greasy fingerprints, and ink from felt tip pens. The color shall be Wilsonart 7022-13, Ironwood or equal. Panels shall be easily replaceable and tamper-resistant. They shall be reinforced, as necessary, to resist vandalism and other rigors of transit bus service. Interior mullion trim, moldings, and trim strips shall be stainless steel, or anodized aluminum. Individual trim panels and parts shall be interchangeable to the extent practical. Untrimmed areas shall be painted and finished to the quality described in Section 3.4.3.8. Samples and color chips shall be supplied by the Contractor at the pre-production meeting, for selection by the Agency.

Interior panel required to meet FMVSS 302.
**Fire Resistance**

**Driver Area Barrier**
An opaque barrier or bulkhead between the operator and the street-side front wheelhouse or passenger seat shall be provided. The driver’s barrier shall extend from the top of the wheel well to the ceiling the level of the seated driver and shall fit close to the bus side windows and wall to prevent passengers from reaching the driver or the driver’s personal effects. The driver barrier shall be positioned to allow full adjustment of the driver's seat, which requires forty-five (45) inches from the heel point. The forward side of the driver barrier shall be painted in matte non-reflective finish. Agency will provide details on drivers barrier to be installed by the Contractor.

Heavy Duty Drivers protection barrier should be priced as an option. TBD at Pre Production.

A sturdy coat hook shall be located in the streetside rear corner of the driver's area. Design of the driver’s barrier and driver’s locker and location of the coat hook is subject to Agency approval during the pre-production design review.

**Modesty Panels**
Sturdy divider panels constructed of durable, unpainted, corrosion-resistant material complementing the interior shall be provided to act as both a physical and visual barrier for seated passengers.

Design and installation of modesty panels located in front of forward-facing seats shall include a handhold or grab handle along its top edge. These dividers shall be mounted on the sidewall and shall project toward the aisle no farther than passenger knee projection in longitudinal seats or the aisle side of the transverse seats. Modesty panels shall extend from at least the window opening of the side windows, and those forward of transverse seats shall extend downward to 1 and 1½ in. above the floor. Panels forward of longitudinal seats shall extend to below the level of the seat cushion. Dividers positioned at the doorways shall provide no less than a 2½ in. clearance between the modesty panel and a fully open, inward opening door, or the path of a deploying flip-out ramp to protect passengers from being pinched. Modesty panels installed at doorways shall be equipped with grab rails if passengers assist are not provided by other means.

The modesty panel and its mounting shall withstand a static force of 250 lbs applied to a 4 × 4 in. area in the center of the panel without permanent visible deformation. The modesty panel and its mounting shall withstand normal kicking, pushing, and pulling loads of 200-pound passengers without permanent visible deformation. Modesty panels shall require approval of the Agency at the pre-production meeting. Modesty panels shall be constructed of materials that discourage graffiti or painted with an anti-graffiti paint or compound.

**Front End**
The entire front end of the bus shall be sealed to prevent debris accumulation behind the dash and to prevent the driver’s feet from kicking or fouling wiring and other equipment. The front end shall be free of protrusions that are hazardous to passengers standing at the front of the standee line area of the bus during rapid decelerations. Paneling across the front of the bus and any trim around the driver’s compartment shall be formed metal or composite material. Composite dash panels shall be reinforced as necessary, vandal-resistant and replaceable. All colored, painted and plated parts forward of the driver’s barrier shall be finished with a surface that reduces glare. Any mounted equipment must have provision to support the weight of equipment. All colored, painted, and plated parts forward of the driver's barrier shall be finished with a dull matte surface. Colors shall be black or coordinate with the balance of the bus interior. Color chips shall be supplied by the Contractor for approval by the Agency at the pre-production meeting.
Rear Bulkhead
The rear bulkhead and rear interior surfaces shall be material suitable for exterior skin; painted and finished to exterior quality; or paneled with melamine-type material, composite, scratch-resistant plastic or carpeting and trimmed with stainless steel, aluminum or composite.

The rear bulkhead paneling shall be contoured to fit the ceiling, side walls and seat backs so that any litter or trash will tend to fall to the floor or seating surface when the bus is on a level surface. Any air vents in this area shall be louvered to reduce airflow noise and to reduce the probability of trash or litter being thrown or drawn through the grille. If it is necessary to remove the panel to service components located on the rear bulkhead, the panel shall be hinged or shall be able to be easily removed and replaced. Grilles where access to or adjustment of equipment is required shall be heavy-duty and designed to minimize damage and limit unauthorized access.

Headlining
Ceiling panels shall be made of durable, corrosion resistant, easily cleanable material. Headlining shall be supported to prevent buckling, drumming or flexing and shall be secured without loose edges. Headlining materials shall be treated or insulated to prevent marks due to condensation where panels are in contact with metal members. Moldings and trim strips, as required to make the edges tamperproof, shall be stainless steel, aluminum or plastic, colored to complement the ceiling material. Headlining panels covering operational equipment that is mounted above the ceiling shall be on hinges for ease of service but retained to prevent inadvertent opening. Samples and color chips shall be supplied by the Contractor at the pre-production meeting for selection by the Agency.

Fastening
Interior panels shall be attached so that there are no exposed unfinished or rough edges or rough surfaces. Fasteners should be corrosion resistant. Panels and fasteners shall not be easily removable by passengers. Exposed interior fasteners should be minimized, and where required shall be tamper-resistant.

Insulation
Any insulation material used between the inner and outer panels shall minimize the entry and/or retention of moisture. Insulation properties shall be unimpaired during the service life of the bus. Any insulation material used inside the engine compartment shall not absorb or retain oils or water and shall be designed to prevent casual damage that may occur during maintenance operations. Insulation properties shall be unimpaired by vibration compacting or settling during the life of the bus. The insulation material shall be non-asbestos, non-hygroscopic and resistant to fungus and breeding of insects.

The combination of inner and outer panels on the sides, roof, wheel wells and ends of the bus, and any material used between these panels, shall provide a thermal insulation sufficient to meet the interior temperature requirements. The bus body shall be thoroughly sealed so that the driver or passengers cannot feel drafts during normal operations with the passenger doors closed.

FMVSS 302
Insulation shall meet the requirements of FMVSS 302.

Floor Covering
The floor covering shall have a non-skid walking surface that remains effective in all weather conditions. The floor covering, as well as transitions of flooring material to the main floor and to the entrance and exit area, shall be smooth and present no tripping hazards. Seams shall be sealed/welded per manufacturer’s specifications. The standee line shall be approximately 2 in. wide and shall extend across the bus aisle. The color and pattern shall be consistent throughout the floor covering. The floor covering shall be Altro FLOOR COVERING manufacturer altro.
Floor covering color tone single color tone throughout bus - defaulted
Standee line color yellow (screaming yellow) - default
Door nosing color yellow (screaming yellow) with aluminum backing plate - default
Floor type altro transfloor chroma phantom
Tfer2272-2772
Aisle color
Underseat-wheelchair position
Color
Drivers platform area trim
Edging
Yellow altro @ foot area and black vinyl @ seat platform area -
Defaulted
Drivers platform foot area
Cover color
TFM27892 Black - DEFAULTED or Deviation, and meet the requirements of the National Floor Safety Institute (NFSI) standards. Floor and step treads if applicable with coverings applied, shall withstand a static load of at least 150 pounds applied through the flat end of a one-half (1/2) inch diameter rod, with 1/32-inch radius, without permanent visible deformation.

The methodology and the type of adhesive used to bond the floor covering to the bus floor shall be as recommended by the manufacturer of the floor covering. All seams and edges of the floor covering shall be sealed to prevent water from entering between floor and covering. The floor covering seams shall be a minimum of eight (8) inches from seams in the sub-floor material.

**Vestibule**
The floor in the vestibule shall be covered with nonskid, composition material that remains effective in all weather conditions. During the pre-production meetings, The Agency will review with the contractor the need to reduce the flooring material thickness in this area to reduce tripping hazards. The floor covering, as well as transitions of flooring material to the main floor and to the step-well area, shall be smooth and present no tripping hazards. The standee line shall be at least two (2) inches wide and shall extend across the bus aisle in line with the driver's barrier. This line shall be the same contrasting yellow color as the edge at the doorway. Color shall be consistent throughout the floor covering.

**Driver’s Compartment**
The floor in the driver's compartment shall be easily cleaned and shall be arranged to prevent debris accumulation. Floor coverings shall be heavy-duty composition, material. Color of the driver's floor covering shall be coordinated with the vestibule. The floor covering shall extend to the sidewalls, up to the top of a cove arrangement, and be secured at the edges, similar to the passenger compartment.

**Passenger Area**
The floor in the passenger area shall be covered with nonskid composition material that remains effective in all weather conditions. To the maximum extent practical flooring shall be installed with a center strip that extends between the aisle sides of transverse seats from the rear seat or rear steps to the standee line. The covering between the center strip and the wheel housings may be separate pieces. At the rear door, however, a separate strip as wide as the doors may extend from the center strip to the edge at the door opening.

The floor covering shall closely fit the side wall cove or extend to the top of the cove. Floor covering material shall cover the rear bench seat riser. Color of the floor covering in the passenger compartment shall be the same as that in the vestibule.
**Interior Lighting**

The light source shall be located to minimize windshield glare, with distribution of the light focused primarily on the passengers’ reading plane while casting sufficient light onto the advertising display. The lighting system may be designed to form part of or the entire air distribution duct.

The lens material shall be translucent polycarbonate. Lenses shall be designed to effectively “mask” the light source. Lenses shall be sealed to inhibit incursion of dust and insects yet be easily removable for service. Access panels shall be provided to allow servicing of components located behind light panels. If necessary, the entire light fixture shall be hinged.

3.1.1.2 Passenger Interior Lighting:

All interior and overhead lighting shall be LEDs. The overhead lighting system shall be IO Controls, or Deviation Overhead lighting shall provide general illumination in the passenger compartment and shall be controlled by a three (3) position switch convenient to the driver with the following functions:

- **ALL** - All passenger lights on
- **OFF** - All passenger lights off
- **REAR** - Rear passenger lights on

LED light fixtures shall be located above the side windows at or near the juncture of the bus ceiling and the sidewall and may be provided over the rear door. Safety mechanism shall prevent fixtures from falling more than eight (8) inches upon occurrence of a mounting failure. Fluorescent lighting shall not be installed above the driver's side window and the front door.

Lamp fixtures and lenses shall be fire-resistant and compliant to NFPA130 requirement for lighting fixtures and shall not drip flaming material onto seats or interior trim if burned. Advertising media located in this area shall be illuminated by direct lighting. No advertisement frames shall be illuminated from behind the media.

A doorway and rear step lighting system shall be illuminated when the master switch is in RUN and NIGHT RUN positions, except the front doorway which shall be extinguished when the front door is closed. Illumination shall be provided by LED strip lighting at both locations. The system shall provide no less than two (2) foot-candles of illumination on the steps and in the entry and exit areas or on the ramp when deployed. These lights shall be shielded to protect passengers' eyes from glare. Light fixtures shall be totally enclosed, water tight, and manufactured from a non-corrosive material designed to provide ease of cleaning as well as lamp and housing removal, and shall not be easily removable by passengers. Doorway and step lights shall be protected from damage caused by passengers kicking lenses or fixtures and shall not be a hazard to passengers.

3.1.1.2.1 Passenger Information & Advertising:

Advertising media eleven (11) inches high and 0.09 inches thick shall be retained near the juncture of the bus ceiling and side-wall. This is not required on the suburban buses.

Passenger All interior lighting shall be turned off whenever the transmission selector is in reverse and the engine run switch is in the “on” position.

The interior lighting design shall require the approval of the Agency.
First Light Modules Dim/Extinguish When Front Door is Closed
When the master switch is in the “run” or “night/run” mode, all street side lights of the coach shall automatically extinguish or dim when the front door is in the closed position and illuminate when the door is opened. This shall be accomplished through the use of I.O. system.

Driver Area
The driver’s area shall have a light to provide general illumination, and it shall illuminate the half of the steering wheel nearest the driver to a level of 5 to 10 foot-candles.

Seating Areas
The interior lighting system shall provide a minimum 15 foot-candle illumination on a 1 sq ft plane at an angle of 45 degrees from horizontal, centered 33 in. above the floor and 24 in. in front of the seat back at each seat position. Allowable average light level for the rear bench seats shall be 7 foot-candles.

Vestibules/Doors
Floor surface in the aisles shall be a minimum of 10 foot-candles, and the vestibule area a minimum of 4 foot-candles with the front doors open and a minimum of 2 foot-candles with the front doors closed. The front entrance area and curb lights shall illuminate when the front door is open and master run switch is in the “lights” positions. Rear exit area and curb lights shall illuminate when the rear door is unlocked.

Step Lighting
Step lighting for the intermediate steps between lower and upper floor levels shall be a minimum of 4 foot-candles and shall illuminate in all engine run positions. The step lighting shall be low-profile to minimize tripping and snagging hazards for passengers and shall be shielded as necessary to protect passengers’ eyes from glare.

Ramp Lighting

(Reserved)

Farebox Lighting
Farebox Light
A light fixture shall be mounted in the ceiling above the farebox location. The fixture shall be capable of projecting a concentrated beam of light on the farebox. This light will automatically come on whenever the front doors are opened and the run switch is in the “night run” or “night park” position.

Fare Collection
Space and structural provisions shall be made for installation of currently available fare collection devices and shall be as far forward as practicable. Location of the fare collection device shall not restrict traffic in the vestibule, including wheelchairs if a front door loading device is used, and shall allow the driver to easily reach the farebox controls and to view the fare register. The fare box shall not restrict access to the driver area, shall not restrict operation of driver controls and shall not — either by itself or in combination with stanchions, transfer mounting, cutting and punching equipment, or route destination signs — restrict the driver’s field of view per SAE Recommended Practice J1050. The location and mounting of the fare collection device shall allow use, without restriction, by passengers. The fare box location shall permit accessibility to the vault for easy manual removal or attachment of suction devices. Meters and counters on the fare box shall be readable on a daily basis. The floor under the fare box shall be reinforced as necessary to provide a sturdy mounting platform and to prevent shaking of the fare box.
Farebox
A floor mounted electronic registering farebox as specified by the Agency complete with DBA, Cashbox ID, and Electronic Locks, and a Ticket Reader/Issue Machine (TRIM) or Deviation complete with mounting brackets shall be provided by the contractor. All space, electrical, and structural provisions shall be made for this installation. The Agency shall approve the final installation of this equipment prior to delivery.

The final installation shall be compatible with the design and layout of the passenger assist bars in the vestibule area of the bus and shall meet all requirements of the Americans with Disabilities Act (ADA) of 1990.

The fare collection system requires two twenty (20) amp, (24) volt nominal DC protected circuit. (24) volts minimum is required to operate the fare collection system regardless of whether the bus engine is running. Center tapping of the batteries for (24) volt supply will not be accepted. J-1708 cable will be routed from bottom of the Farebox to the Tech box. Cat6 ethernet cable will be installed, terminated with 8P8C type connector in the RJ45 wiring standard and certified. The ethernet cable will be installed same as J-1708 but routed to the onboard modem in the Tech Box.

The design and layout of the driver’s area shall be such that access for maintenance of the installed fare collection equipment shall not require the removal of any on-board equipment. Also, driver’s controls and general area shall not be restricted. From a seated position, the driver shall be able to reach all of the controls on the farebox, such as the coin dump/hold buttons and the data registers, as well as view the inspection windows and display of the fare collection system without interference.

The clear area for access to the driver’s area shall be a minimum of ten (10) inches when measured from the farebox to the driver’s seat base. The floor under the fare collection equipment shall be reinforced with one-quarter (¼) inch steel (minimum) to provide a sturdy mounting platform to prevent shaking of the equipment while the bus is in operation.

The farebox shall be loaded with the latest firmware, boot and software versions available for each order.

Interior Access Panels and Doors
Access for maintenance and replacement of equipment shall be provided by panels and doors that appear to be an integral part of the interior. Access doors shall be hinged with gas props or over-center springs, where practical, to hold the doors out of the mechanic’s way. Panels shall prevent entry of mechanism lubricant into the bus interior. All fasteners that retain access panels shall be captive in the cover.

Access Doors with Locks
Access doors shall be secured with locks. The locks shall be standardized so that only one tool is required to open access doors on the bus. The tool shall be determined at the pre-production meeting. Commuter coach luggage compartments shall be secured with keyed locks.

Floor Panels
Access openings in the floor shall be sealed to prevent entry of fumes and water into the bus interior. Flooring material at or around access openings shall be flush with the floor and shall be edge-bound with stainless steel or another material that is acceptable to the Agency to prevent the edges from coming loose. Access openings shall be asymmetrical so that reinstalled flooring shall be properly aligned. Fasteners shall tighten flush with the floor.

The number of special fastener tools required for panel and access door fasteners shall be minimized. All interior access doors and related fasteners are subject to approval at the pre-production meeting.
PASSENGER ACCOMMODATIONS

THE AGENCY REQUEST OPTION QUOTES FOR AMERICAN SEATING CLASSIC, KIEL CITOS AND USSC ARIES 4MA. WILL MAKE FINAL DECISION WITH COLOR ETC AT PRE PRODUCTION OR BEFORE.

Passenger Seating

Arrangements and Seat Style
The passenger seating arrangement in the bus shall be such that seating capacity is maximized and in compliance to the following requirements. All seats will be equipped with USB charging ports, the location will be approved by the Agency at Pre-Production meeting.

The Agency recognizes that ramp location, foot room, hip-to-knee room, doorway type, width, seat construction, floor level type, seat spacing requirements, ramp or lift, number of wheelchair positions, etc. ultimately affect seating capacity and layout.

Proposers are requested to submit to the Agency up to three (3), seating arrangements that otherwise meet the requirements of this specification. The submissions should include seating arrangements that represent both the maximum and minimum seating allowable to include: line drawings or renderings; number of seats; number and location of mobility aid and priority seating; number of standees; estimated curb weight of vehicle; the gross load and resultant gross vehicle weight rated. This section, not withstanding, the current design criteria shall be as follows. Seat colors shall be provided at the pre-production meeting.

Replace with current build information Rearward facing seats are not permitted and the seating capacity with this arrangement shall be no less than 37 for the 40-foot urban bus, 26 for the 30-foot urban bus.

Forward-Facing Seat Configuration
Passenger seats shall be arranged in a transverse, forward-facing configuration, except at the wheel housings and turntable, if applicable, where aisle-facing seats may be arranged as appropriate with due regard for passenger access and comfort. Other areas where aisle-facing seats may be provided are at wheelchair securement areas and platforms (such as for fuel tank storage space).

Rearward Facing Seats
Rearward facing seats not allowed.

(Reserved)

Padded Inserts/Cushioned Seats
Non-Padded Inserts and Seat Configuration
The passenger seats shall be equipped with non-padded inserts throughout the bus.

Fully Cushioned Seats (Suburban and Commuter Coach)
The passenger seats shall be fully cushioned throughout the bus (measure to compressed surface, 150-lb person).

Drain Hole in Seats
No requirements for drain hole provision in seat inserts.
**Hip-to-Knee Room**

Hip-to-knee room measured from the center of the seating position, from the front of one seat back horizontally across the highest part of the seat to vertical surface immediately in front, shall be a minimum of 26.5 in. At all seating positions in paired transverse seats immediately behind other seating positions, hip-to-knee room shall be no less than 27 in.

**Foot Room**

Foot room, measured at the floor forward from a point vertically below the front of the seat cushion, shall be no less than 14 in. Seats immediately behind the wheel housings and modesty panels may have foot room reduced, if the seating is designed to allow the passenger to rest their feet on an angled portion of the wheel housing, but shall have foot room no less than nine inches. Thickness of the transverse seat backs shall be designed to allow optimum passenger knee room and bus capacity.

**Aisles**

The aisle between the seats shall be no less than 20 in. wide at seated passenger hip height. Seat backs shall be shaped to increase this dimension to no less than 24 in. at 32 in. above the floor (standing passenger hip height).

**Dimensions**

**FIGURE 7**

Seating Dimensions and Standard Configuration

Seat dimensions for the various seating arrangements shall have the dimensions as follows (refer to Figure 7):
• The width, W, of the two-passenger transverse seat shall be a minimum 35 in.
• The length, L, shall be 17 in., ±1 in.
• The seat back height, B, shall be a minimum of 15 in.
• The seat height, H, shall be 17 in., ±1 in. For the rear lounge (or settee) and longitudinal seats, and seats located above raised areas for storage of under-floor components, a cushion height of up to 18 in., ±2 in., will be allowed. This shall also be allowed for limited transverse seats, but only with the expressed approval of the Agency.
• Foot room = F.
• The seat cushion slope, S, shall be between 5 and 11 degrees.
• The seat back slope, C, shall be between 8 and 17 degrees.
• Hip to knee room = K (26.5 in. min.).
• The pitch, P, is shown as reference only.

Structure and Design
The passenger seat frame and its supporting structure shall be constructed and mounted so that space under the seat is maximized and is completely free of obstructions to facilitate cleaning.

Seats, structures and restraints around the securement area should not infringe into the mobility device envelope or maneuverability.

The transverse seat structure shall be fully cantilevered from the sidewall with sufficient strength for the intended service. The lowest part of the seat assembly that is within 12 in. of the aisle shall be at least 10 in. above the floor.

In locations at which cantilevered installation is precluded by design and/or structure, other seat mounting may be allowed.

All transverse objects — including seat backs, modesty panels, and longitudinal seats — in front of forward-facing seats shall not impart a compressive load in excess of 1000 lbs onto the femur of passengers ranging in size from a 5th-percentile female to a 95th-percentile male during a 10g deceleration of the bus. This deceleration shall peak at 0.05 to 0.015 seconds from initiation. Permanent deformation of the seat resulting from two 95th-percentile males striking the seat back during this 10g deceleration shall not exceed 2 in., measured at the aisle side of the seat frame at height H. The seat back should not deflect more than 14 in., measured at the top of the seat back, in a controlled manner to minimize passenger injury. Structural failure of any part of the seat or sidewall shall not introduce a laceration hazard.

The seat assembly shall withstand static vertical forces of 500 lbs applied to the top of the seat cushion in each seating position with less than ¼-in. permanent deformation in the seat or its mountings. The seat assembly shall withstand static horizontal forces of 500 lbs evenly distributed along the top of the seat back with less than ¼-in. permanent deformation in the seat or its mountings. The seat backs at the aisle position and at the window position shall withstand repeated impacts of two 40-lb sandbags without visible deterioration. One sandbag shall strike the front 40,000 times and the other sandbag shall strike the rear 40,000 times. Each sandbag shall be suspended on a 36-in. pendulum and shall strike the seat back 10,000 times each from distances of 6, 8, 10 and 12 in. Seats at both seating positions shall withstand 4000 vertical drops of a 40-lb sandbag without visible deterioration. The sandbag shall be dropped 1000 times each from heights of 6, 8, 10 and 12 in. Seat cushions shall withstand 100,000 randomly positioned 3½-in. drops of a squirming, 150-lb, smooth-surfaced, buttocks-shaped striker with only minimal wear on the seat covering and no failures to seat structure or cushion suspension components.

The back of each transverse seat shall incorporate a handhold no less than ½ in. in diameter for standees and seat access/egress. The handhold shall not be a safety hazard during severe decelerations. The handhold shall extend
above the seat back near the aisle so that standees shall have a convenient vertical assist, no less than 4 in. long that may be grasped with the full hand. This handhold shall not cause a standee using this assist to interfere with a seated 50th-percentile male passenger. The handhold shall also be usable by a 5th-percentile female, as well as by larger passengers, to assist with seat access/egress for either transverse seating position. The upper rear portion of the seat back and the seat back handhold immediately forward of transverse seats shall be padded and/or constructed of energy absorbing materials. During a 10g deceleration of the bus, the HIC number (as defined by SAE Standard J211a) shall not exceed 400 for passengers ranging in size from a 5th percentile female through a 95th percentile male.

The seat back handhold may be deleted from seats that do not have another transverse seat directly behind and where a vertical assist is provided.

Longitudinal seats shall be the same general design as transverse seats but without seat back handholds. Longitudinal seats may be mounted on the wheelhouses. Armrests shall be included on the ends of each set of longitudinal seats except on the forward end of a seat set that is immediately to the rear of a transverse seat, the driver’s barrier, or a modesty panel, when these fixtures perform the function of restraining passengers from sliding forward off the seat. Armrests are not required on longitudinal seats located in the wheelchair parking area that fold up when the armrest on the adjacent fixed longitudinal seat is within 3½ in. of the end of the seat cushion. Armrests shall be located from 7 to 9 in. above the seat cushion surface. The area between the armrest and the seat cushion shall be closed by a barrier or panel. The top and sides of the armrests shall have a minimum width of 1 in. and shall be free from sharp protrusions that form a safety hazard.

Seat back handhold and armrests shall withstand static horizontal and vertical forces of 250 lbs applied anywhere along their length with less than ¼-in. permanent deformation. Seat back handhold and armrests shall withstand 25,000 impacts in each direction of a horizontal force of 125 lbs with less than ¼-in. permanent deformation and without visible deterioration.

**Construction and Materials**

Selected materials shall minimize damage from vandalism and shall reduce cleaning time. The seats shall be attached to the frame with tamper-resistant fasteners. Coloring shall be consistent throughout the seat material, with no visually exposed portion painted. Any exposed metal touching the sides or the floor of the bus shall be stainless steel. The seat, pads and cushions shall be contoured for individuality, lateral support and maximum comfort and shall fit the framework to reduce exposed edges.

The minimum radius of any part of the seat back, handhold or modesty panel in the head or chest impact zone shall be a nominal ¼-in. The seat back and seat back handhold immediately forward of transverse seats shall be constructed of energy-absorbing materials to provide passenger protection and, in a severe crash, allow the passenger to deform the seating materials in the impact areas. Complete seat assemblies shall be interchangeable to the extent practicable.

Agency to select seat fabric.

**Passenger Assists**

Passenger assists in the form of full grip, vertical stanchions or handholds shall be provided for the safety of standees and for ingress/egress. Passenger assists shall be conveniently located, shape, and size for both the 95th-percentile male and the 5th-percentile female standee. Starting from the entrance door and moving anywhere in the bus and out the exit door, a vertical assist shall be provided either as the vertical portion of seat back assist or as a separate item so that a 5th-percentile female passenger may easily move from one assist to another using one hand and the other without losing support. All handholds and stanchions at front doorway, around farebox,
and at interior steps for bi-level designs. The forward-most vertical stanchions on either side of the aisle immediately behind the driver’s area shall be stainless steel finish.

**Assists**

Excluding those mounted on the seats and doors, the assists shall have a cross-sectional diameter between 1¼ and 1½ in. or shall provide an equivalent gripping surface with no corner radii less than ¼ in. All passenger assists shall permit a full hand grip with no less than 1½ in. of knuckle clearance around the assist. Passenger assists shall be designed to minimize catching or snagging of clothes or personal items and shall be capable of passing the NHTSA Drawstring Test.

Any joints in the assist structure shall be underneath supporting brackets and securely clamped to prevent passengers from moving or twisting the assists. Seat handholds may be of the same construction and finish as the seat frame. Door mounted passenger assists shall be of anodized aluminum, stainless steel or powder-coated metal. Connecting tees and angles may be powder-coated metal castings. Assists shall withstand a force of 300 lbs applied over a 12-in. lineal dimension in any direction normal to the assist without permanent visible deformation. A crash resulting in a one (1) foot intrusion shall not produce sharp edges, loose rails, or other potentially dangerous conditions associated with a lack of structural integrity of the assist. All passenger assist components, including brackets, clamps, screw heads and other fasteners used on the passenger assists shall be designed to eliminate pinching, snagging and cutting hazards and shall be free from burrs or rough edges. All passenger assists, this section notwithstanding, shall comply with ADA, Part 38.29.

**Front Doorway**

Front doors, or the entry area, shall be fitted with ADA-compliant assists. Assists shall be as far outward as practicable, but shall be located no farther inboard than 6 in. from the outside edge of the entrance step and shall be easily grasped by a 5th-percentile female boarding from street level. Door assists shall be functionally continuous with the horizontal front passenger assist and the vertical assist and the assists on the wheel housing or on the front modesty panel. Door entry assists shall be no less than ¾-inch in width and provide a minimum knuckle clearance of 1-½-inch.

**Vestibule**

The aisle side of the driver’s barrier, the wheel housings, and when applicable the modesty panels shall be fitted with vertical passenger assists that are functionally continuous with the overhead assist and that extend to within 36 in. of the floor. These assists shall have sufficient clearance from the barrier to prevent inadvertent wedging of a passenger’s arm.

A horizontal passenger assist shall be located across the front of the bus and shall prevent passengers from sustaining injuries on the fare collection device or windshield in the event of a sudden deceleration. Without restricting the vestibule space, the assist shall provide support for a boarding passenger from the front door through the fare collection procedure. The assist shall be no less than 36 in. above the floor. The assists at the front of the bus shall be arranged to permit a 5th-percentile female passenger to easily reach from the door assist, to the front assist, to vertical assists on the driver’s barrier, wheel housings or front modesty panel.

**Rear Doorway(s)**

Vertical assists that are functionally continuous with the overhead assist shall be provided at the aisle side of the transverse seat immediately forward of the rear door and on the aisle side of the rear door modesty panel(s). Passenger assists shall be provided on modesty panels that are functionally continuous with the rear door assists. Rear doors, or the exit area, shall be fitted with assists having a cross-sectional diameter between 1¼ and 1½ in. or providing an equivalent gripping surface with no corner radii less than ¼ in., and shall provide at least 1½ in. of knuckle clearance between the assists and their mounting. The assists shall be designed to permit a 5th-
percentile female to easily move from one assist to another during the entire exiting process. The assists shall be
located no farther inboard than 6 in. from the outside edge of the rear doorway step.

**Overhead**
Except forward of the standee line and at the rear door, a continuous, full grip, overhead assist shall be provided.
This assist shall be located over the center of the aisle seating position of the transverse seats. The assist shall be
no less than 70 in. above the floor, except over the curbside front wheel housings where the height shall be no less
than sixty (60) inches. A similar assist shall be provided over the streetside wheel housing if it does not preclude
opening the doors of the electronics locker, above the floor.

Grab straps or other extensions as necessary may be provided for sections where vertical assists are not available
and for the use by passengers that cannot reach to 70 in. If provided, grab straps shall be fabric.

Overhead assists shall simultaneously support 150 lbs on any 12-in. length. No more than 5 percent of the full
grip feature shall be lost due to assist supports.

**Longitudinal Seat Assists**
Longitudinal seats shall have vertical assists located between every other designated seating position, except for
seats that fold/flip up to accommodate wheelchair securement. The two most rearward seats on each side shall
have vertical assists at the rearward edge. Assists shall extend from near the leading edge of the seat and shall be
functionally continuous with the overhead assist. Assists shall be staggered across the aisle from each other where
practicable and shall be no more than 52 in. apart or functionally continuous for a 5th percentile female passenger.

**Wheel Housing Barriers/Assists**
Unless passenger seating is provided on top of wheel housing, passenger assists shall be mounted around the
exposed sides of the wheel housings (and propulsion compartments if applicable), which shall also be designed to
prevent passengers from sitting on wheel housings. Such passenger assists shall also effectively retain items, such
as bags and luggage, placed on top of wheel housing.

The front wheel housings shall have vertical assists at the rearmost aisle side corners that are continuous with the
overhead horizontal assists. The curbside front wheel housing shall have a vertical assist at the forward most aisle
side corner that is continuous with the overhead horizontal assist. A horizontal assist approximately 36 inches
above the floor and on top of the wheel housing shall be installed along the aisle side of the curbside wheel
housing. A similar assist shall be provided on the streetside wheel housing if it does not preclude opening the
doors of the electronics locker.

Assists shall be provided on both sides of the aisle steps in the rear of the bus. Assists shall be no less than thirty-
six (36) inches above the floor and step tread surface and shall be functionally continuous with vertical assists in
the low floor area and on the modesty panels in the high floor area.

**Passenger Doors**
All passenger door designs shall conform to the minimum clearance requirements of ADA 38.25C. The front
door shall be of the Vapor Slide Guide Class III design or Deviation. The rear door shall be two-section outward
opening, manually opened by passengers and closed by Vapor Electric Door System mechanism or Deviation.
Front and rear door equipment shall be common to the maximum extent practicable.

Doors shall be equipped with stanchions, actuators, lighting, emergency overrides and other equipment necessary
to allow safe and efficient passenger ingress and egress. The rear door, if required, will be interlocked.
Two (2) doors shall be provided on the curbside of the 40 foot urban transit configuration bus equipped with stanchions, actuators, lighting, emergency overrides and other equipment necessary to allow safe and efficient passenger ingress and egress. One door shall be provided on the curbside of the 30-foot urban transit configuration bus, the suburban bus, and the commuter coach bus.

### TABLE 7
Door Locations and Styles

<table>
<thead>
<tr>
<th>Location</th>
<th>Slide Glide</th>
<th>Double (Two-Piece Pantograph)</th>
<th>Single (One-Piece Pantograph)</th>
<th>Outside Sliding Plug</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front Door</td>
<td>Slide Guide</td>
<td>&quot;X&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Slide Glide</td>
<td>Double (Two-Piece Pantograph)</td>
<td>Single (One-Piece Pantograph)</td>
<td>Outside Sliding Plug</td>
</tr>
<tr>
<td>Rear Doors(s)</td>
<td>Slide Guide</td>
<td>Outward Opening Swing With Manual Emergency Reset</td>
<td>Outward Opening Swing With Auto Emergency Reset</td>
<td>Double (Two-Piece Pantograph)</td>
</tr>
<tr>
<td>Curbside doorway located in front of the rear axle.</td>
<td>Slide Guide</td>
<td>&quot;X&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### TABLE 8
Door Operating Combinations

<table>
<thead>
<tr>
<th>Front</th>
<th>Curbside Rear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>Open</td>
<td>Closed</td>
</tr>
<tr>
<td>Open</td>
<td>Open</td>
</tr>
<tr>
<td>Closed</td>
<td>Open</td>
</tr>
</tbody>
</table>

### Materials and Construction

Structure of the doors, their attachments, inside and outside trim panels and any mechanism exposed to the elements shall be corrosion-resistant. Door panel construction shall be of corrosion-resistant metal or reinforced non-metallic composite materials. When fully opened, the doors shall provide a firm support and shall not be damaged if used as an assist by passengers during ingress or egress. Door edges shall be sealed to prevent infiltration of exterior moisture, noise, dirt and air elements from entering the passenger compartment, to the maximum extent possible based on door types.

The closing edge of each door panel shall have no less than 2 in. of soft weather stripping. The doors, when closed, shall be effectively sealed, and the hard surfaces of the doors shall be at least 4 in. apart. The combined
weather seal and window glazing elements of the front door shall not exceed 10 degrees of binocular obstruction of the driver’s view through the closed door.

**Dimensions**

![Figure 8: Transit Bus Minimum Door Opening](image)

When open, the doors shall leave an opening no less than 75.3 in. in height.

**31¾-in. Minimum Doorway Clear Width**

Front door clear width shall be a minimum of 31¾ in. with the doors fully opened.

Rear door opening clear width shall be a minimum of 24 in. with the doors fully opened. If a rear door ramp or lift is provided, then the clear door opening width shall be a minimum of 31¾ in. with door fully opened. Door design shall require review and concurrence of the Agency at the pre-production meeting.

**Door Glazing**

Each section of both front and rear doors shall be glazed with ¼ inch nominal laminated glass. The edge of a six (6) inch high curb shall be visible to the seated driver through the closed front door when the bus is more than twelve (12) inches from the curb. Glazing material and tint shall be the same for both front and rear doors.

Door glazing shall be easily replaceable with a quick change glazing exterior frame.

The front door panel glazing material shall have a nominal ¼ in. thick tempered glass conforming with the requirements of ANSI Z26.1 Test Grouping 2 and the Recommended Practices defined in SAE J673.

Glazing material in the rear doorway door panels shall be defined by the Agency.
**Door Projection**

**Exterior**
The exterior projection of the front doors beyond the side of the bus shall be minimized and shall not block the line of sight of the rear exit door via the curb side mirror when the doors are fully open. The exterior projection of both doors shall be minimized and shall not exceed 13 in. during the opening or closing cycles or when doors are fully opened.

**Interior**
Projection inside the bus shall not cause an obstruction of the rear door mirror or cause a hazard for standees. Projection inside the bus shall not exceed twenty (20) inches.

**Door Height Above Pavement**
It shall be possible to open and close either passenger door when the bus loaded to gross vehicle weight rating is not knelt and parked with the tires touching an 8-in.-high curb on a street sloping toward the curb so that the street side wheels are 5 in. higher than the right side wheels.

**Closing Force**
Closing door edge speed shall not exceed 12 in. per second, and opening door speed shall not exceed 19 in. per second. Power doors shall not slam closed under any circumstance, even if the door is obstructed during the closing cycle. If a door is obstructed during the closing cycle, the pressure exerted on the obstruction shall not increase once initial contact has been made.

Power-close rear doors shall be equipped with an obstruction sensing system such that if an obstruction is within the path of the closing doors, the doors will stop and/or reverse direction prior to imparting a 10-lb force on 1 sq in. of that obstruction. If a contactless obstruction sensing system is employed, it shall be capable of discriminating between the normal doorway environment and passengers or other obstructions within the doorway, and of altering the zones of detection based upon the operating state of the door system.

Doors closed by a return spring or counterweight-type device shall be equipped with an obstruction-sensing device that, at a minimum, alerts the driver if an obstruction is detected between the closing doors. Doors closed by a return spring or counterweight type device, when unlocked, shall be capable of being pushed to the point where the door starts to open with a force not to exceed 25 lbs applied to the center edge of the forward door panel.

Whether or not the obstruction sensing system is present or functional, it shall be possible to withdraw a 1½ in. diameter cylinder from between the center edges of a closed and locked door with an outward force not greater than 35 lbs.

**Actuators**
Doors shall open or close completely in not more than 3.5 seconds from the time of control actuation and shall be subject to the closing force requirements.

Door actuators shall be adjustable so that the door opening and closing speeds can be independently adjustable to satisfy the above requirements. Actuators and the complex door mechanism shall be concealed from passengers but shall be easily accessible for servicing. The door actuators shall be rebuildable. If powered by compressed air, exhaust from the door system shall be routed below the floor of the bus to prevent accumulation of any oil that may be present in the air system and to muffle sound.

Door actuators and associated linkages shall maximize door holding forces in the fully open and fully closed positions to provide firm, non-rattling, non-fluttering door panels while minimizing the force exerted by the doors.
on an obstruction midway between the fully open and closed positions. All elements of the door and actuator system shall operate without a Class 3 failure for 50,000 miles on the design operating profile.

The rear door operating mechanism, mounted on a removable steel base plate in a compartment directly above the door, shall be a Vapor Corporation Class III, or Deviation, mechanical lock/electric unlock type. Door in closed position shall be locked by a spring-loaded lock lever. To unlock door, lock lever shall be retracted by an electrical solenoid that is energized from a switch in driver's door control valve. When unlocked, door shall be able to be manually opened. The rate of closing shall be adjustable, with a speed control on the electric motor.

A Components Concept BD100102B warning chime or Deviation, shall sound at the rear doors for two (2) seconds upon initiation of the door close command (Component Concepts Inc., P.O. Box 370055, West Hartford, CT 06137-0055, 860-523-4066). The chime shall sound when the doors recycle from the sensitive edge obstruction detection system. The chime quality and volume shall be approved at the pre-production meeting.

An interior mounted green warning light, visible to passengers inside and outside the bus, shall flash for two (2) seconds upon initiation of the door closed command. The visual warning light operation shall be synchronized with the operation of the audible warning device.

The rear doors shall be passenger-controlled. The vehicle operator shall unlock and enable the opening mechanism, which shall be annunciated by illumination of a green light near the door. After enabling and unlocking, the doors shall be opened by either the passenger manually pushing the door open, or by a powered mechanism actuated by passenger activation of a touch bar or touch switch, or by passenger activation of a contactless sensing system.

A switch located within reach of the seated operator shall, when actuated, restore rear door function to complete operator control, as described in the “Default.”

Doors that employ a “swing” or pantograph geometry and/or are closed by a return spring or counterweight-type device shall be equipped with a positive mechanical holding device that automatically engages and prevents the actuation mechanism from being back-driven from the fully closed position. The holding device shall be overcome only when the driver’s door control is moved to an “Exit Door Enable” position and the vehicle is moving at a speed of less than 2 mph, or in the event of actuation of the emergency door release.

Locked doors shall require a force of more than 300 lbs to open manually. When the locked doors are manually forced to open, damage shall be limited to the bending of minor door linkage with no resulting damage to the doors, actuators or complex mechanism.

**Rear Door Interlocks**
See “Hardware Mounting” for door system interlock requirements.

**Emergency Operation**
In the event of an emergency, it shall be possible to manually open doors designated as emergency exits from inside the bus using a force of no more than 25 lbs after actuating an unlocking device. The unlocking device shall be clearly marked as an emergency-only device and shall require two distinct actions to actuate. The respective door emergency unlocking device shall be accessible from the doorway area. The unlocking device shall be easily reset by the operator without special tools or opening the door mechanism enclosure. Doors that are required to be classified as “Emergency Exits” shall meet the requirements of FMVSS 217.

Closed rear door shall be positively locked, requiring a force of more than 100 pounds to open manually. Slide–glide type rear doors are considered positively locked when bus door motor is applied on the...
closing side of the door motor and the actuator is properly adjusted to the supplier's procedure. Required opening forces shall be essentially linear or increasing with distance the doors are ajar to open. The door motors may provide a secondary force holding the doors closed, but shall not be the primary lock. When the locked doors are manually forced open, damage shall be limited to the bending or breaking of door linkage with no resulting damage to the doors, motors, and mechanism. In the event of an emergency, it shall be possible to open the front, or rear doors manually from inside the bus using a force of no more than twenty-five (25) pounds after actuating an unlocking device at each door. The unlocking devices shall be clearly marked as an emergency device and shall require two distinct actions for activation to occur. The door emergency unlocking devices shall be accessible from the door egress area and shall be protected by a clear breakaway plastic cover. The devices shall be encased in a hinged compartment and retained by an approved latch. A decal with operational instructions shall be provided at each emergency door unlocking device. The decal shall have red text stating “To Open Door Manually Break Turn Handle”. When the rear door emergency device is actuated the interlock system shall be activated.

Door Control
The door control shall be located in the operator’s area within the hand reach envelope described in SAE Recommended Practice J287, “Driver Hand Control Reach.” The driver’s door control shall provide tactile feedback to indicate commanded door position and resist inadvertent door actuation.

Door control located on street side.

The front door shall remain in commanded state position even if power is removed or lost.

Door Controller
Five-Position Driver’s Door Controller
The control device shall be protected from moisture. Mounting and location of the door control device handle shall be designed so that it is within comfortable, easy arm’s reach of the seated driver. The door control device handle shall be free from interference by other equipment and have adequate clearance so as not to create a pinching hazard.

Position of the door control handle shall result in the following operation of the front and rear doors:

- **Center position**: Front door closed, rear door(s) closed or set to lock.
- **First position forward**: Front door open, rear door(s) closed or set to lock.
- **Second position forward**: Front door open, rear door(s) open or set to open.
- **First position back**: Front door closed, rear door(s) open or set to open.
- **Second position back**: Front door open, rear door(s) open or set to open.

Rear Door Operation
The exit door shall be equipped with a Vapor Bus International CLASS III™ contactless acoustical sensing system, or Deviation, employing three acoustical sensors and will be equipped with passenger assists designed as to avoid interference with the detection zones of the acoustical sensors and shall meet the general ADA requirements of passenger assist size, strength and knuckle clearance. Passenger assists shall be located near the opened edge of the door panels and extend from 36 inches above the floor surface to within 36 inches of the street surface. The door shall be opened, after unlocking by the driver, when a passenger attempts to touch the center edge of either door panel in the area of a decal displaying signage approved by the authority. This action by the passenger when the door is enabled will signal the door operator to open. The doors shall begin to close after the acoustical sensors cease to detect an object or passenger in the doorway. During the door closing cycle the CLASS™ sensing system will signal the doors to reopen should one of the acoustical sensors detect the presence...
of a passenger or obstruction in the doorway. The door closing speed shall be adjustable and not exceed 12 inches per second for closing. Exit doors shall be kept in the closed position by a positive locking mechanism, not just by spring force.

Door Open/Close

Operator-Controlled Front and Passenger-Controlled Rear Doors with Provision for Driver Override

Operation of, and power to, the front passenger doors shall be completely controlled by the operator. Power to rear doors shall be controlled by operator. After enabling, the rear doors shall be opened by the passenger. A switch shall be provided to enable the driver to obtain full control of the rear doors.

A control or valve in the operator’s compartment shall shut off the power to, and/or dump the power from, the front door mechanism to permit manual operation of the front door with the bus shut down. A master door switch, which is not within reach of the seated operator, when set in the “off” position shall close the rear/center doors, deactivate the door control system, release the interlocks, and permit only manual operation of the rear/center doors.

Accessibility Provisions

Space and body structural provisions shall be provided at the front or rear door of the bus to accommodate a wheelchair loading system.

Loading Systems

There are three options:

- high-floor lift
- low-floor ramp
- platform (boarding bridgeplate) level boarding

Lift

The wheelchair lift control system must be capable of receiving multiplex command from vehicle interlocks.

An automatically controlled, power-operated wheelchair ramp or lift system compliant to requirements defined in 49 CFR 571.403 (FMVSS 403) shall provide ingress and egress quickly, safely and comfortably, both in forward and rearward directions, for a passenger in a wheelchair from a level street or curb.

General Requirements

The design and construction of the bus shall be in accordance with all requirements defined in 49 CFR, Part 38, Subpart B: ADA Accessibility Specifications for Transportation Vehicles—Buses, Vans and Systems. Space and body structural provisions shall be provided at the front door of the bus to accommodate the mobility aid, loading ramp. The ramp and mechanism shall be protected from collision damage, damage from curbing the bus, corrosion, the entrance of water, sand and salt and objects deflected from the right of way.

The mobility aid ramp shall be a Lift-U LU 18(6:1) Foldout, located at front door or Deviation and provide safe, comfortable and rapid ingress and egress for passengers using mobility aid devices either from the street level or curb. The system shall be designed to operate in an urban environment service area where curb heights may reach fourteen (14) inches and varying degrees of road crown. The ramp shall be designed to protect the device from damage and persons on the sidewalk from injury during the extension and lowering phases of operation. The mobility aid ramp system shall not present a hazard, nor inconvenience to any passenger.
**Design Requirements**
The ramp shall support a load of 950 pounds, placed at the center of the ramp distributed over an area of twenty-six (26) inches by twenty-six (26), with a safety factor of at least three (3) based on the ultimate strength of material. The transition from roadway or sidewalk and the transition from the bus floor to the ramp may be vertical without edge treatment up to one-quarter (¼) inch. Changes in level greater than one-quarter (¼) inch, but no more than one-quarter (½) inch, shall be beveled with a slope no greater than 1:2. The loading platform shall be covered with a replaceable or renewable, non-skid material and shall be fitted with barriers at least two (2) inches high to prevent the mobility aid devices from rolling off the ends or sides during loading or unloading. The ramp shall be firmly attached to the vehicle and no gap between the ramp and its sections or the vehicle shall exceed five-eighths (5/8) inch. The ramp shall be furnished with anti-skid tape which has an adhesive backed laminate. The ramp shall not have protrusions from the surface greater than one-quarter (¼) inch high; shall have a clear width of thirty (30) inches.

**Ramp Operation**
The loading operation shall be under the surveillance and complete control of the operator. Stowing or deploying the ramp shall require two separate and distinct actions by the operator. A guarded master switch in the operator’s console shall disable ramp operation. The controls shall be simple to operate with no complex phasing operation required and should be integrated with the bus kneeling system to insure minimum ramp slope to street level. The four-way hazard warning lights shall be automatically activated when the ramp master switch is in the enabled or on position at the operator’s console. The ramp shall be incapable of stowing when a passenger is on the ramp. The safeguards incorporated into the ramps operation to prevent accidental stowing of the ramp with a passenger on the ramp shall not cause damage to the ramp or mechanism. The bus shall be prevented from moving during ramp system operation by a throttle and brake interlock.

The loading platform shall be covered with a replaceable or renewable nonskid material and shall be fitted with devices to prevent the wheelchair from rolling off the sides during loading or unloading.

Deployment or storage of the ramp shall require no more than 15 seconds. The device shall function without failure or adjustment for 500 cycles or 5000 miles in all-weather conditions on the design operating profile when activated once during the idle phase. A manual override system shall permit unloading a wheelchair and storing the device in the event of a primary power failure. The manual operation of the ramp shall not require more than 35 lbs of force.

(Reserved)

(Reserved)

**Wheelchair Accommodations**

**NOTE:** Agency will approve acceptable securement system.

**Two Forward-Facing Wheelchair Securement Locations**

Two forward-facing locations, as close to the wheelchair loading system as practical, shall provide parking space and securement system compliant with ADA requirements for a passenger in a wheelchair. Passenger seats in these positions may be replaced or modified to provide parking space and secure tie-downs for passengers with disabilities. The securement system shall be American Seating ARM for transit buses and Secura for coaches, with Q’Straint or Secura or Deviation. Securement devices and optional seatbelts shall be of sufficient length to accommodate electrically powered mobility aids.

All passenger securement devices must be stowed off the floor and out of the way when not in use.
Interior Circulation
Maneuvering room inside the bus shall accommodate easy travel for a passenger in a wheelchair from the loading device and from the designated securement area. It shall be designed so that no portion of the wheelchair protrudes into the aisle of the bus when parked in the designated parking space(s). When the positions are fully utilized, an aisle space of no less than 20 in. shall be maintained. As a guide, no width dimension should be less than 34 in. Areas requiring 90-degree turns of wheelchairs should have a clearance arc dimension no less than 45 in., and in the parking area where 180-degree turns are expected, space should be clear in a full 60-in.-diameter circle. A vertical clearance of 12 in. above the floor surface should be provided on the outside of turning areas for wheelchair footrest. The securement devices shall include a retracting device positioned to keep belts off the floor and allow for maneuvering of mobility aid device into position.

SIGNAGE AND COMMUNICATION

Destination Signs

General Requirements
A Twin Vision, or Deviation electronic all LED destination sign system shall be supplied for the bus with destination signs for the front, side, and rear of the bus plus a route number sign on the dash. The electronic destination information system shall be ADA compliant. The LED’s on all signs shall be Silver / White in color.

The display areas of the destination signs shall be clearly visible in direct sunlight, at night and in all lighting conditions between these lighting extremes with evenly distributed illumination appearance. Each destination sign shall have equal readability at points 65 degrees on either side of a line perpendicular to the center of the mean plane of the sign’s display. The Contractor shall comply with the destination sign manufacturers’ recommended mounting configuration and installation procedures to assure optimum visibility of the sign display.

Easy access shall be provided to clean the inside of the destination sign glass or to repair, remove or replace the sign mechanism. Self-retained, quarter-turn fasteners or four-turn speed-thread screws shall be provided to aid in quick removal of components. The sign enclosure shall inhibit entry of dirt, dust, insects, or driven rain under normal operating conditions. Laminated safety glass or tempered glass shall be used for the front destination sign window. The glass shall be electrically heated whenever the defroster fan is ON. The multiplex electrical control system shall cycle the heater on/off to assure maximum durability of the heating element and effective defrosting. The front sign cavity shall also be heated by the bus main HVAC system.

The system shall be microprocessor based and utilize EIA RS-485, SAE J1708, SAE J1939, or CAN communications protocols between system components, and shall utilize error detection techniques within the communication protocol. The system shall generally be capable of communicating with and/or controlling, additional information devices, such as interior information signs or visual and voice annunciation devices. The system shall provide for destination and public relations message entry and display. System shall communicate with the Trapeze IVLU and receive remote programming of the signs.

The system shall have the ability to sequentially display multi-line destination messages, with the route number portion remaining in a visible constant “ON” mode at all times, if so programmed. It shall provide the means of adjusting, from one-tenth second to twenty-five seconds duration, the length of time messages are displayed.

Front Destination Sign
The front destination sign shall have a minimum of sixteen (16) rows by 160 columns in a display sixty-three (63) inches wide by nine (9) inches high. The destination message shall be readable by a person with 20/20 vision from a distance, not less than 350 feet. Update with new white light sign, smart sign Twin Vision or Deviation
**Side Destination Sign**
The side destination sign shall be located at the top of the forward most curbside window and shall have a minimum of fourteen (14) rows by 108 columns in a display forty-two (42) inches wide by 4.2 inches high. The side destination message shall be readable by a person with 20/20 vision from a distance of not less than 110 feet. Update with new white light sign, smart sign Twin Vision or Deviation.

**Rear Destination Sign**
The rear destination sign shall have a minimum of sixteen (16) rows by forty-eight (48) columns in a display seventeen (17) inches wide by 6.1 inches high. The rear sign shall be capable of independently displaying alphanumeric characters. The rear destination sign message shall be readable by a person with 20/20 vision from a distance of not less than 225 feet. Rear destination sign housing should be recessed inside rear panel behind glass cover.

**Operator Control Unit**
The driver’s control console (OCU) shall be recess mounted in the front destination compartment door within reach of the driver. The OCU shall contain a display of at least two-lines of twenty (20) character capability, to monitor the status of the destination sign system and shall incorporate an audio, annunciator that beeps to alert the driver to view the display for a message, or beeps indicating that a key is depressed. The OCU shall utilize a multi-key keyboard designed for transit use. The OCU shall continuously display the message that the front signs are displaying except the emergency message when initiated.

**Interconnection Cables**
The system shall include all required signal interconnect cables. Signal connectors shall be polarized and cables shall have strain relief. This cabling should include a cable from the OCU to the IVLU for the remote programming capabilities.

Message Programming Capability. Update with new white light sign, smart sign Twin Vision or Deviation

The destination sign system on the bus shall be re-programmable with the use of an industry standard Flash PC-Card. A hardware/software package necessary for wireless message transfer shall be provided to generate message lists for the destination sign system. If using the PC-Card, a software package necessary to program PC-Cards shall be provided with five PC-Cards included. Software package shall run on Agency approved version of Microsoft Windows.

The programming software shall be “user friendly” in that the user interface is designed to have the following features:

a) Rational prompts for user input,
b) A tree or menu structure,
c) Require minimal printed documentation,
d) Facilitates ease of training, and
e) Incorporates context-sensitive help features.

It shall provide the capability of custom message writing by selection of preprogrammed standard variable width fonts and by creation of custom fonts by varying spacing between characters, words, or other message elements. It shall allow creation of graphic displays, with or without text; by selecting preprogrammed graphic sign images.
and by the use of multiple fonts within the same message allowing graphic symbols to be placed anywhere within the display area.

Buses shall be delivered with a pre-programmed list of destination sign messages, supplied by the Agency. The various signs on a bus shall be programmable to display independent messages or the same messages. The destination sign system shall allow two destination messages and one public relations message to be pre-selected and the operator shall be able to change between the pre-selected destination messages without entering a new message code. Public relations messages shall be capable of being displayed alternately with the regular text and route messages or displayed separately.

An emergency message, described in the Emergency Alarm specifications of Section TS 9 Engine, shall be activated by the hoodlum alarm switch, located in the driver’s compartment. The Emergency message shall be displayed on signs facing outside the bus while signs inside the bus, including the DCC display, remain unchanged or display a special message specified by the Agency. To reset the message displayed on the destination signs after deactivation by the hoodlum alarm the operator must use the OCU and perform the following sequence of operations:

a) Press "Destination A" or "Destination B"
b) Enter the new destination of the bus
c) Press "Enter" key

Memory Capacity
A two line memory capacity of 27,000 to 40,000 message units of information is required.

Auto-Blanking
When the vehicle master run switch is in the “OFF” position, the entire display area of all destination signs shall automatically blank within ten minutes.

Destination Display Design
Sign displays shall be complete amber colored LED dot pixels. The LEDs shall be the only means of illumination of the sign message display area. The display elements shall operate in the static electricity environment generated during normal bus operation and satisfy a useful life of a minimum of 100,000 hours.

Vibration and Shock
The system shall be capable of withstanding a continuous 60-minute one (10 g-minimum vibration over a frequency range of five (5) to fifty (50) Hz without degradation. It shall also be capable of withstanding repeated 10g half sine pulse shocks for ten (10) milliseconds without degradation.

Power Input and Regulation
The system shall operate properly over a voltage range of eleven (11) to thirty-two (32) VDC.

FCC Compliance
The system shall comply with FCC Regulation Docket 20780 covering EMI and RFI emissions, and shall operate properly under the following conditions:

a) With signal and power cables routed as close as six inches from any receiver/transmitter cables
b) With system hardware, including power and signal cables, mounted as close as three feet from any antennas.
**Route Number Sign**
An electronic three-digit letter or number sign assembly shall be installed on the dash near the entrance door. The sign shall have a minimum of 14 rows x 36 columns. The installation location is to be approved by the Agency.

**Passenger Information and Advertising**

**Interior Displays**
Provisions shall be made on the rear of the driver’s barrier or equipment box located on the wheel well for a frame to retain information such as routes and schedules.

Advertising media 11 in. high and 0.09 in. thick shall be retained near the juncture of the bus ceiling and sidewall. The retainers may be concave and shall support the media without adhesives. The media shall be illuminated by the interior light system.

Next stop display.

**Exterior Displays**
No provisions for exterior advertising displays.

**Passenger Stop Request/Exit Signal**

**Use for Touch Tape Passenger Signal**
A passenger “stop requested” signal system that complies with applicable ADA requirements defined in 49 CFR, Part 38.37 shall be provided. The system shall consist of a touch tape, chime, and interior sign message. The touch tape shall be accessible to all seated passengers, with provisions for standees. It shall be easily accessible to all passengers, seated or standing. Vertical touch tape shall be provided at each window mullion and adjacent to each wheelchair parking position and priority seating positions.

A "Stop Requested" message in amber letters shall be illuminated when the passenger "Stop Requested" signal system is activated. The "Stop Requested" message shall remain visible until one or both passenger doors are opened. The message shall be visible to the seated operator and seated passengers. The operator shall be able to deactivate the signal system from the operator's area. A green LED light shall be mounted above the rear door, approximately on center of the rear door actuator compartment access panel, to indicate when the rear doors have been unlocked.

**Pull Cord Passenger Signal**
A passenger “stop requested” signal system that complies with applicable ADA requirements defined in 49 CFR, Part 38.37 shall be provided. The system shall consist of a heavy-duty pull cable, chime and interior sign message. The pull cable shall be located the full length of the bus on the sidewalls at the level where the transom is located. If no transom window is required, the height of the pull cable shall approximate this transom level and shall be no greater than 63 in. as measured from the floor surface. It shall be easily accessible to all passengers, seated or standing. Pull cable(s) shall activate one or more solid state or magnetic proximity switches. At each wheelchair passenger position and at priority seating positions, additional provisions shall be included to allow a passenger in a mobility aid to easily activate the “stop requested” signal.

An auxiliary passenger “stop requested” signal shall be installed at the rear door to provide passengers standing in the rear door/exit area convenient means of activating the signal system. The signal shall be a heavy-duty push button type located in the rear door vicinity. Button shall be clearly identified as “passenger signal.”

A single “stop requested” chime shall sound when the system is first activated. A double chime shall sound anytime the system is activated from wheelchair passenger areas.
Exit signals located in the wheelchair passenger area shall be no higher than 4 feet above the floor. Instructions shall be provided to clearly indicate function and operation of these signals.

**Communications**

**Electronics Cabinet**

Given the anticipated design and the horizontal surface over the streetside front wheelhouse, a full size electronics cabinet shall be provided to accommodate the two-way radio, ITS equipment and inclusion of the overall electronic systems in the bus. The cabinet shall meet appropriate NEMA standards and must be approved by the Agency.

The electronics cabinet shall be splash-proof when the service door is secured and made of a minimum of twelve (12) gauge stainless steel or fourteen (14) gauge 5052 H32 aluminum construction, suitably reinforced. The cabinet shall be painted with polyurethane enamel in a color selected by the Agency to complement the interior and it shall be securely mounted on top of the streetside wheel housing. Access to the cabinet shall be from a lockable hinged door opening into the passenger aisle area that includes a sturdy hold-open device. The cabinet door shall have a recessed handle and a lock, keyed alike, with four keys per vehicle.

The cabinet shall provide a minimum of 46 inches of free height that accommodates four shelves of standard nineteen (19) inch electronic racks of eighteen (18) inch depth. Provisions shall be provided to receive a laptop computer while repair personnel are interfacing with the diagnostic test ports, the shelf shall prevent the laptop from falling while the bus is motion. Power provisions shall be made for the radio and Vehicle Logic Units (excluding multiplexing) inside the electronics cabinet. Circuits and wiring for each system shall be independent of one another and rated per the manufacturer’s specifications. 12VDC, 24VDC supplies and a chassis ground shall be provided on three (3) independent terminal strips with a minimum of six (6) terminal mounting locations. Terminal strips shall be clearly identified. Terminal strips and associated wiring shall not interfere with shelf operation.

Diagnostic test ports and ECM interfaces for all of the vehicles systems shall be mounted inside of the electronics locker on a single test panel. The test ports shall be clearly identified. The design of the test panel shall be reviewed during the pre-production meeting.

The cabinet shall be provided with a terminal of the VLAN system (reference Section 3.6.4). A three (3) inch inside diameter conduit shall connect the cabinet with the main bus wiring harnesses above the streetside lighting fixtures. A 2-1/4 inch inside diameter metallic conduit shall connect the control head and radio control unit with the electronics cabinet.

The electronics cabinet shall provide adequate ventilation for 750 watts of equipment operating within the range of −20°F to +140°F. The design and configuration of the cabinet shall be subject to Agency approval during the pre-production process.

**Intelligent Transportation System**

The Agency currently utilizes a Trapeze, Inc. Intelligent Transportation System (ITS). The ITS system encompasses Computer Aided Dispatch, (CAD), Automated Vehicle Location (AVL), Automated Vehicle Monitoring (AVM), Traffic Prioritization and Automatic Passenger Counter (APC). The contractor is responsible to provide an equivalent system from Trapeze, Inc., that is currently in use by the Agency.

The Contractor shall install a Dinex Output Interface Module G4 or Deviation compatible with the Trapeze IVLU V8 in order to complete the installation of the Trapeze ITS on the bus. This Output Interface Module is required to extract signals currently provided via the multiplexing system from the drivers LED panel. The Agency requires that ground signals be provided. All signal wires will be connected to terminal strips and the wires will be clearly labeled at each end. The terminal strip and the terminal identification decal shall be provided...
on the interior of the electronics cabinet door. Upon review of the driver LED panel, the Agency will request specific signals be wired from the LED panel to the electronics locker via the gateway module. An example of the requested signals will be:

a) Door Open.
b) A/C Fail.
c) Retarder OFF.
d) Low Air.
e) E-Stroke.
f) Check Engine.
g) Stop Engine.
h) Check Transmission.
i) Stop Request.
j) ABS Warning.
k) DPF Warning
l) Engine Compartment Fire

m) Hot brakes

n) Underinflated tires

o) Deployed bike rack

**NOTE:** Signals may be changed during the thirty (30) days design review of the pilot bus.

The contractor shall review and confirm with the Agency all integration and interface requirements with the ITS during the initial design review meetings. The fully integrated ITS shall be installed on the pilot bus for evaluation during the thirty (30) day testing and demonstration program. The Contractor shall be responsible for the integration, installation and testing of the ITS on every vehicle prior to delivery to the Agency including the interface with the existing system.

**Wireless Local Area Network (WLAN):**
The vehicle WLAN component is embedded in the ITS Controller™ and enables high-speed communications to and from the vehicle using the IEEE 802.11b standards. Onboard data is stored in the ITS Controller™ non-volatile memory. During vehicle power up or down sequences, a connection is made automatically with the IP-based SFTP server. Data is then uploaded from the vehicle and stored on the server for integration and summarization into the TransitMaster™ database. The contractor is responsible for the connection to the WLAN at the Agency.

WLAN is used to transfer data to and from the vehicle fleet including:

**Download to Vehicle**
- Route and schedule files
- Canned message updates
- ITS Controller™ software updates
- Automated annunciation system announcements
- Vehicle configuration modifications

**Upload from Vehicle**
- Vehicle diagnostic information
- Automatic passenger count information
- Stored operational messages

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Vehicle Local Area Network
The Contractor shall install and verify the operability of a Vehicle Local Area Network (VLAN) in accordance with SAE Recommended Practice J1708, Serial Data Communications Between Microcomputer Systems in Heavy-Duty Applications, SAE Recommended Practice J1587, Joint SAE/TMC Electronic Data Interchange Between Microcomputer Systems in Heavy-Duty Vehicle Applications and SAE Recommended Practice J2496, Transport Area Network Cabling. The VLAN shall initiate from the Electronics Locker and have Device Access Boxes in strategic locations throughout the bus identified by the Agency.

The VLAN shall provide the inter connectivity of all elements of the Bus Communication System, and all other equipment on the bus with microprocessor controls. Functionally, the VLAN shall support an environment where all components, modules, and systems installed on the bus shall have built-in diagnostics capability. The diagnostic system shall be capable of checking the communications between all components of the installed systems.

Mobile Radio System
A mobile radio system shall be provided for each bus. The radio shall be a Motorola APX 4500 with Sierra Wireless MG90 model, or Deviation to transmit data from Trapeze. The radio shall include an operator speaker, the handset described in Section TS 83.4.2 Handset, and cradle and shall be programmable with multiple channels. A location convenient to the operator shall be provided for the radio control head, speaker, handset, and cradle. The location shall conform to SAE Recommended Practice J287 “Driver Hand Control Reach.”

The system shall be in conformance to the mobile radio system supplier’s instructions. The Contractor shall provide all material required to install the radio system beyond the brackets and harnesses provided by the radio manufacturer. A mobile radio will be provided by the Agency for the pilot bus to allow confirmation of the communications system integration during the thirty (30) day pilot bus testing and demonstration program.

Communication Antennas
Provisions for attaching the three Bus Communication System antennas to the roof and routing antenna leads to the communication devices shall include a ¾-inch inside diameter conduit with a pull wire. The mounting for all antennas and lead terminations shall be accessible from the bus interior.

A low profile Panorama SW3-686 antenna mutually compatible with the mobile radio unit shall be installed on the roof of the bus near the front and on the roof centerline. The antenna shall function optimally in the 821/866 MHz band and shall be enclosed in a weather resistant housing of plastic or composite material. The antenna mounting and enclosure shall resist bus washing equipment and weathering throughout the life of the bus.

Low profile type antennas mutually compatible with the Sierra Wireless MG90 Firstnet compatible Modem shall be installed on the roof of the bus near the front and on the roof streetside. The antenna mounting and enclosure shall resist bus washing equipment and weathering throughout the life of the bus.

A separate GPS antenna is required and shall be installed on the roof near the front of the vehicle with an unobstructed line of sight to the sky (satellite surveillance). Commercially available GPS antennas are packaged within a rugged, protective enclosure and are not to be covered or otherwise obstructed by any other form of enclosure or baffle. Typically an RG-316RF Double Shielded Cable, or equivalent, is installed as the antenna cable and can neither be pinched nor contain sharp bends.

A third antenna is required for the WLAN system. The antenna shall be mounted at the front of the bus and be in accordance with the Siemens ITS requirements.
The antenna lead for the mobile radio shall be a rugged, heat resistant RG58\U coaxial cable operating in the 821/866 MHz band. The cable center shall be stranded or solid pure copper and the shield shall be braided copper. The dielectric insulation material shall be made of type FEP fluorocarbon foam, and the protective jacket shall be made of solid type FEP fluorocarbon. The cable shall exhibit no greater than ten (10) decibels of attenuation per one hundred-foot length, at 821/866 MHz. Low loss, vibration and corrosion resistant radio frequency (RF) connectors, designed to mate with antenna base and transceiver unit, shall be utilized at both ends of the antenna cable.

Antenna leads for other Bus Communication System components shall be of premium construction and shall meet equipment supplier specifications.

**Video Surveillance System**

The Contractor shall provide and install a Video surveillance system, as well as sufficient shelf space in the contractor provided lockable enclosure (equipment cabinet) for the on-board security camera equipment outlined in this section. The Contractor will be installing the surveillance equipment (i.e., DVRs, Cameras, Microphones, etc.)

**VIDEO SURVEILLANCE SYSTEM:**

Vehicles shall include an On-board Digital Video Surveillance System capable of supporting up to twelve (12) analog cameras and up to thirty-two (32) IP cameras. The system must be fully compatible with CATS existing Transit Solutions (TSI) Nexview software suite. This system shall include a Transit Solutions (TSI) Nexus-HVR (Hybrid Video Recorder) or Deviation. The onboard video surveillance system shall also include all necessary components for total system functionality comprised of the following components (Note: All equipment locations specified below are approximate. Final locations shall be reviewed and approved by CATS at or before the pre-production meeting.):

**Vehicle Equipment (Quantity Per Vehicle):**

- One (1) TSI NEXUS-HVR (Hybrid Video Recorder), or Deviation capable of supporting up to (12) analog cameras and/or (32) IP cameras or any combination thereof.
- One (1) Removable Disk Drive (RDD) with a minimum of 4TB capacity.
- One (1) 8 port POE switch with 2 high-speed uplink ports
- One (1) GPS Receiver
- Eight (8) IP Cameras in the following locations:
  - One (1) interior color IP camera to be mounted inside the bus facing forward through the front windshield to capture the road view. Camera shall support a resolution of 1080p or better. Camera shall include integrated audio.
  - One (1) exterior color IP camera viewing the Curb Side Exterior of the bus. Camera shall support a resolution of 1080p or better and be a minimum IP67 rated.
  - One (1) exterior color IP camera viewing the Street Side Exterior of the bus. Camera shall support a resolution of 1080p or better and be a minimum IP67 rated.
  - One (1) exterior color IP camera viewing the rear of the bus. Camera shall support a resolution of 1080p or better and be a minimum IP67 rated.
  - One (1) interior color IP camera for viewing the Front Passenger Entry Door. Camera shall support a resolution of 1080p or better. Camera shall include integrated audio.
  - One (1) interior color IP camera for viewing the Front Passenger Seating Area. Camera shall support a resolution of 1080p or better. Camera shall include integrated audio.
• One (1) interior color IP camera for viewing the Rear Passenger Entry Door. Camera shall support a resolution of 1080p or better. Camera shall include integrated audio.
• One (1) interior color IP camera for viewing the Rear Passenger Seating Area. Camera shall support a resolution of 1080p or better. Camera shall include integrated audio.
• One (1) 802.11ac wireless access point with one (1) antenna for automatic video query and video event download.
• Discrete signal interface for the following:
  o Left Turn Signal (operational)
  o Right Turn Signal (operational)
  o Brake Operation

The bus digital video security recording system shall not interfere electrically with the operation of the transit bus or with its onboard electronic equipment such as the radio, farebox, engine controls, transmission or other electronic equipment. Furthermore, the unit shall be FCC tested and approved. The digital video recorder shall be installed in a lockable cabinet or enclosure.

The system shall be installed according to industry standards meeting Society of Automotive Engineers recommended practices. All cables, wiring, interconnections, switches, and circuit breakers/fuses shall be heavy-duty and specifically designed for their purposes and automotive application. The selected wire sizes and insulation shall be based on the current carrying capability voltage drop, mechanical strength temperature and flexibility requirements. Video and audio wires selected shall be gauged to minimize signal loss.

**IP Camera Specifications:**

The Exterior IP cameras on this installation shall have a minimum rating of IP67. The cameras shall automatically switch from color to black & white recording in low light conditions via integrated IR LED’s. The enclosures shall be vandal resistant, secure, lockable, shock-resistant, dust resistant and weather and water-resistant and shall be made of impact-resistant non-toxic material.

All Interior IP cameras shall have a built-in microphone, and the ability to automatically switch from color to black & white recording in low light conditions via integrated IR LED’s.

**Hybrid Video Recorder (HVR) Specifications:**

The HVR shall be capable of being mounted in any orientation without detriment to its operation.

The HVR shall have two (2) Ethernet ports to allow external programming and system diagnostics. Built-in software shall perform full and continuous system diagnostics and is capable of reporting failures.

The HVR shall require no operator interface other than the Master Switch operation to effectuate operation, initiate shutdown, maintain the system, service or program the system, or prepare the system for operation.
The HVR operating system software shall be of an embedded type contained within a firmware chip. The operating system shall be written specifically for HVR operation and allow for the largest available drives to be used. Consumer-based operating systems residing on internal hard drives are not acceptable because they are subject to frequent failure.

The HVR shall have the ability to record twelve (12) analog channels and up to thirty-two (32) IP cameras via optional TSI network switches.

The HVR shall be capable of recording up to (32) channels of digitized audio via external IP cameras with integrated microphones.

In addition to accurate time and date, the HVR shall append with image data the following five (5) signal and alarm programmable analog vehicle parameters and the buses in this procurement shall be equipped and delivered recording these vehicle parameters:

- vehicle speed
- left signal (directional)
- right signal (directional)
- brake operation
- event switch

The HVR shall have the ability to dynamically change video and audio settings during operation. Frame rates range up to 30 fps per camera. The HVR shall be capable of recording multiple differing frame rates and differing levels of image quality per camera at the same time.

The HVR shall maintain a log file of its actions, which are stored on the removable hard drive. This information includes the time and date of the action and includes: ignition on/off, events start and stop, camera failure, drive errors, and other diagnostics.

The HVR shall comply with all the requirements of the "Buy America Act" (49 CFR Part 661), at the component level.

The HVR shall have the capability to interface with diagnostic software operated from either a workstation or portable computer for system troubleshooting and configuration purposes.

The HVR shall interface with a Panic/Event Button that will be hardwired to CATS preferred CAD/AVL supplier’s emergency alarm button. When a system input such as an emergency alarm button is activated the video recording unit shall tag the event. When retrieved, the tagged event shall be easily identifiable.

**Removable Disk Drive (RDD) Specifications:**
The removable drive shall be secured in place by a key lock mounted on the HVR. Total storage capacity shall be at least 4 TB (terabytes).

Duration of recording on the removable disk drive (RDD) is determined by video capture quality, drive size, and aggregate frame rate. The RDD shall support a minimum of 3-weeks of recording with eight cameras.

**802.11ac Wireless Specifications:**

The HVR shall support wireless connectivity. Data from the hard drive canister shall be transferable via a compatible 802.11ac wireless Ethernet Bridge and downloadable to a server via a wireless network. The transferred or downloaded data shall be reviewable by a workstation that has an installed copy of the vendor's video reviewing software. The system shall also be capable of delivering video data and system health status information automatically to the server for review.

**Cable Harness Specifications:**

The Contractor shall provide and install a cable harness for the Agency’s camera surveillance system. All cable for the Security Camera System shall be installed in appropriately sized conduit and in accordance with the specifications outlined in this section.

The Contractor shall provide and install an on-board security camera system cable harness that meets the following specifications:

- 16 AWG – 3 Conductor power cable from a 24V power source to the equipment cabinet
- 18 AWG – 2 Conductor accessory cable shall be used for powering the 802.11AC access point and connecting to the CAD/AVL vendors emergency alarm switch.
- CAT6 Stranded Ethernet Cabling, with vibration resistant “locking” boot, that can be “unlocked” by hand without the use of a tool. This cabling shall be run from the HVR’s “Network Switch” location to each of the applicable IP camera locations, and between the HVR’s “Network Switch” and the 802.11AC Access Point.
- All cable shall be routed from the Equipment Cabinet to each device such that the cable is hidden behind panels and out of view. All cable shall have approximately 1 foot of service loop left available on each end. All cable running with at least one other cable in a span shall be zip-tied every 12” until the service loop. At all points where cable passes through interior or exterior body panels, cable shall be loomed to protect the cable from chaffing.
- At points where all cables unite and pass into the equipment cabinet from other locations within the bus, the cable shall be loomed, with appropriately sized loom, and secured at both ends with electrical tape. The last 36” of cable shall be exposed at the end of the harness to breakout different device cable to its proper DVR connection location.

All cable for the Security Camera System shall be installed in appropriately sized conduit and in accordance with the specifications outlined in this section. Final harness and conduit installation plans and layouts shall be approved by CATS at the pre-production meeting.
All equipment locations specified below are approximate. Final locations for coiled cable shall be reviewed and approved by CATS at or before the pre-production meeting.

**Cable Terminations**

All cable shall be terminated using the following connector types. Specific size of connectors (BNC, molex, etc.) shall be finalized as part of the pre-production meeting.

1. **Camera Cable Connectors**
   All camera cable (camera signal portion) shall be terminated with male BNC connectors and crimped accordingly using appropriate specialized BNC crimping tools.

   All camera cable (Siamese 2 conductor portion of the cable) shall be terminated on the camera end with a two pin male Molex connector. This connector shall be applied using appropriate specialized Molex crimping tools.

   All camera cable (Siamese 2 conductor portion of the cable) on the DVR end shall be terminated with #10 ring terminals to connect to the bus bar mounted in the Equipment Cabinet (see below).

2. **Access Point Power Cable Connectors**
   All access point power cable shall be terminated on the access point end with a two pin male molex connector. This connector shall be applied using appropriate specialized Molex crimping tools.

   All access point power cable shall be terminated on the DVR end with two #10 ring terminals for power.

3. **Access Point Ethernet Cable Connectors**
   All access point Ethernet cable shall be pre-terminated, pre-molded, with RJ45 connectors at both ends.

4. **Event Button Cable Connectors**
   All event button cable shall be terminated on the event button end with .187 female disconnects to connect to the event button terminals.

   All event button cable shall be terminated on the DVR end with bare leads.

5. **DVR Power Cable Connectors**
   All DVR power cable shall be connected to 24V constant power (white insulator within 16 AWG 3 conductor cable), 24V ignition (green insulator within 16 AWG 3 conductor cable), and ground (black insulator within 16 AWG 3 conductor cable). The constant power and ignition power shall be fused with 10 Amp and 3 Amps fuses respectively. These cables shall be properly capped so as to eliminate the chance of a short before the system is installed.

**Equipment Cabinet Terminal Strip (Bus Bars)**
The equipment cabinet shall come equipped with four bus bars, each with four #10 posts, for device power from the DVR. These bus bars shall be mounted within the equipment that will allow for easy removal of connected #10 ring terminals.

**Cable Routing, Securing and Labeling**

All cable shall be routed from the Equipment Cabinet to each device such that the cable is hidden behind panels and out of view. All cable shall have approximately 1 foot of service loop left available on each end. All cable running with at least one other cable in a span shall be zip-tied every 12” until the service loop. At all points where cable passes through interior or exterior body panels, cable shall be loomed to protect the cable from chaffing.
All cable shall be individually labeled with the device name for that specific cable, at both ends of the cable. Labels shall be approximately 6” from cable ends.

**Cable Loom**
At points where all cables unite and pass into the equipment cabinet from other locations within the bus, the cable shall be loomed, with appropriately sized loom, and secured at both ends with electrical tape. The last 36” of cable shall be exposed at the end of the harness to breakout different device cable to its proper DVR connection location.

**Public Address System**
A public address system shall be provided on each bus for facilitating radio system and driver-originated announcements to passengers.

The Automated Voice Annunciation System (AVA)/Public Announcement (PA) shall provide automatic passenger information, including the capacity to provide automatic interior and exterior announcements and automatically display text messages on an interior sign as required by the Americans with Disabilities Act. The system shall interface with the destination sign system.

A Automated Voice Annunciation System (AVA)/Public Announcement (PA) or Deviation Talking Bus System compatible with the existing Trapeze AVL system used by the Agency and shall be provided and installed per Agency configuration. An all LED interior Variable Message sign compatible with Automated Voice Annunciator System shall be provided. *Interior message signs shall be connected to the AVL system via J-1708 or similar connectivity to provide remote programming capabilities via the Trapeze AVL system.*

The PA system shall include a hands free microphone which, when activated, shall override any ongoing automated announcement. The switch shall be supplied and installed by the Contractor to permit the bus operator to trigger individual announcement whenever needed using the hands free microphone. The location of the switch and hands free microphone shall be approved by the Agency.

**Speakers**
Eight (8) interior loudspeakers shall be provided, semi-flush mounted, on alternate sides of the bus passenger compartment, installed with proper phasing. Speakers shall have a minimum flat response of 100-15,000Hz. Total impedance seen at the input connecting end shall be 8 Ohms. Mounting shall be accomplished with riv-nuts and machine screws. The speaker wires shall be run to a terminal block in the Electronics Locker. The speaker installation locations and materials shall be approved by the Agency, in advance of actual installation.

One (1) loudspeaker shall be provided and mounted outside the bus near the front door to allow communications to passengers outside the bus. A weatherproof, non-corrosive, cone type exterior speaker shall be used.

**Automatic Passenger Counter (APC)**
An IRIS Matrix Automatic passenger system shall be installed. The APC shall be capable of providing passenger counts, both ingress and egress, for each doorway. The sensors shall be mounted overhead in brackets, not in the baseplate. The APC shall integrate and communicate with the AVL system.
Radio Handset and Control System

Drivers Speaker
Each bus shall have a recessed speaker in the ceiling panel above the driver. This speaker shall be the same component used for the speakers in the passenger compartment. It shall have 8 Ohms of impedance.

Handset
Contractor will install to the right side of the dash an handset, model number to be specified by the agency, or approved equal, for driver use.

Driver Display Unit (DDU)
Contractor shall install a driver display unit as close to the driver’s instrument panel as possible.

Emergency Alarm
Contractor shall install an emergency alarm that is accessible to the driver but hidden from view.
SECTION 7: WARRANTY REQUIREMENTS

Basic Provisions

Warranty Requirements

Contractor Warranty

Warranties in this document are in addition to any statutory remedies or warranties imposed on the Contractor. Consistent with this requirement, the Contractor warrants and guarantees to the original Agency each complete bus and specific subsystems and components as follows. Performance requirements based on design criteria shall not be deemed a warranty item.

Complete Bus

The complete bus, propulsion system, components, major subsystems and body and chassis structure are warranted to be free from Defects and Related Defects for one year or 50,000 miles, whichever comes first, beginning on the date of revenue service but not longer than 15 days after acceptance under “Inspection, Testing and Acceptance.” The warranty is based on regular operation of the bus under the operating conditions prevailing in the Agency’s locale.

Body and Chassis Structure

Body, body structure, structural elements of the suspension and engine cradle are warranted to be free from Defects and Related Defects for three years or 150,000 miles, whichever comes first.

Primary load-carrying members of the bus structure, including structural elements of the suspension, are warranted against corrosion failure and/or Fatigue Failure sufficient to cause a Class 1 or Class 2 Failure for a period of 12 years or 500,000 miles, whichever comes first.

Propulsion System

Propulsion system components, specifically the engine, transmission or drive motors, and generators (for hybrid technology) and drive and non-drive axles shall be warranted to be free from Defects and Related Defects for the standard two years or 100,000 miles, whichever comes first. An Extended Warranty to a maximum of five years or 300,000 miles, whichever comes first, may be purchased at an additional cost. The propulsion system manufacturer’s standard warranty, delineating items excluded from the Extended Warranty, submitted in accordance with the Request for Pre-Offer Change or Deviation or with the Form for Proposal Deviation.

Emission Control System (ECS)

The Contractor warrants the emission control system for five years or 100,000 miles, whichever comes first. The ECS shall include, but is not limited to, the following components:

- complete exhaust system, including catalytic converter (if required)
- after-treatment device
- components identified as emission control devices

Subsystems

Other subsystems shall be warranted to be free from Defects and Related Defects for two years or 100,000 miles, whichever comes first. Other subsystems are listed below:

- Brake system: Foundation brake components, including advancing mechanisms, as supplied with the axles, excluding friction surfaces.
- Destination signs: All destination sign equipment for the front, side and rear signs, power modules and operator control.
- Heating, ventilating: Roof and/or rear main unit only, excluding floor heaters and front defroster.
- AC unit and compressor: Roof and/or rear main unit only, excluding floor heaters and front defroster.
- Door systems: Door operating actuators and linkages.
- Air compressor
- Air dryer
- Wheelchair lift and ramp system: Lift and/or ramp parts and mechanical only
- Starter
- Alternator: Alternator only. Does not include the drive system.
- Charge air cooler: Charge air cooler including core, tanks and including related surrounding framework and fittings.
- Fire suppression: Fire suppression system including tank and extinguishing agent dispensing system
- Hydraulic systems: Including radiator fan drive and power steering as applicable.
- Engine cooling systems: Radiator including core, tanks and related framework, including surge tank.
- Transmission cooler
- Passenger seating excluding upholstery
- Fuel storage and delivery system
- Surveillance system including cameras and video recorders

Extended Warranty
- No provisions for extended warranties.

Serial Numbers
Upon delivery of each bus, the Contractor shall provide a complete electronic list of serialized units installed on each bus to facilitate warranty tracking. The list shall include, but is not limited to:

- engine
- transmission
- alternator
- starter
- A/C compressor and condenser/evaporator unit
- drive axle
- power steering unit
- fuel cylinders (if applicable)
- air compressor
- wheelchair ramp (if applicable)

The Contractor shall provide updated serial numbers resulting from warranty campaigns. The format of the list shall be approved by the Agency prior to delivery of the first production bus.

Extension of Warranty
If, during the warranty period, repairs or modifications on any bus are made necessary by defective design, materials or workmanship but are not completed due to lack of material or inability to provide the proper repair for thirty (30) calendar days, the applicable warranty period shall be extended by the number of days equal to the delay period.

Voiding of Warranty
The warranty shall not apply to the failure of any part or component of the bus that directly results from misuse, negligence, accident or repairs not conducted in accordance with the Contractor-provided maintenance manuals and with workmanship performed by adequately trained personnel in accordance with recognized standards of the industry. The warranty also shall be void if the Agency fails to conduct normal inspections and scheduled preventive maintenance procedures as recommended in the Contractor’s maintenance manuals and if that
omission caused the part or component failure. The Agency shall maintain documentation, auditable by the Contractor, verifying service activities in conformance with the Contractor’s maintenance manuals.

**Exceptions and Additions to Warranty**

The warranty shall not apply to the following items:

- scheduled maintenance items
- normal wear-out items
- items furnished by the Agency

Should the Agency require the use of a specific product and has rejected the Contractor’s request for an alternate product, then the standard Supplier warranty for that product shall be the only warranty provided to the Agency. This product will not be eligible under “Fleet Defects,” below.

The Contractor shall not be required to provide warranty information for any warranty that is less than or equal to the warranty periods listed.

**Pass-Through Warranty**

Should the Contractor elect to not administer warranty claims on certain components and wish to transfer this responsibility to the sub-Suppliers, or to others, the Contractor shall request this waiver.

Contractor shall state in writing that the Agency’s warranty reimbursements will not be impacted. The Contractor also shall state in writing any exceptions and reimbursement including all costs incurred in transport of vehicles and/or components. At any time during the warranty period, the Contractor may request approval from the Agency to assign its warranty obligations to others, but only on a case-by-case basis approved in writing by the Agency. Otherwise, the Contractor shall be solely responsible for the administration of the warranty as specified. Warranty administration by others does not eliminate the warranty liability and responsibility of the Contractor.

**Superior Warranty**

The Contractor shall pass on to the Agency any warranty offered by a component Supplier that is superior to that required herein. The Contractor shall provide a list to the Agency noting the conditions and limitations of the Superior Warranty not later than the start of production. The Superior Warranty shall not be administered by the Contractor.

**Fleet Defects**

**Occurrence and Remedy**

A Fleet Defect is defined as cumulative failures of twenty-five (25) percent of the same components in the same or similar application in a minimum fleet size of twelve (12) or more buses where such items are covered by warranty. A Fleet Defect shall apply only to the base warranty period in sections entitled “Complete Bus,” “Propulsion System” and “Major Subsystems.” When a Fleet Defect is declared, the remaining warranty on that item/component stops. The warranty period does not restart until the Fleet Defect is corrected.

For the purpose of Fleet Defects, each option order shall be treated as a separate bus fleet. In addition, should there be a change in a major component within either the base order or an option order, the buses containing the new major component shall become a separate bus fleet for the purposes of Fleet Defects.

The Contractor shall correct a Fleet Defect under the warranty provisions defined in “Repair Procedures.” After correcting the Defect, the Agency and the Contractor shall mutually agree to and the Contractor shall promptly undertake and complete a work program reasonably designed to prevent the occurrence of the same Defect in all other buses and spare parts purchased under this Contract. Where the specific Defect can be solely attributed to
particular identifiable part(s), the work program shall include redesign and/or replacement of only the defectively designed and/or manufactured part(s). In all other cases, the work program shall include inspection and/or correction of all of the buses in the fleet via a mutually agreed-to arrangement. The Contractor shall update, as necessary, technical support information (parts, service and operator’s manuals) due to changes resulting from warranty repairs. The Agency may immediately declare a Defect in design resulting in a safety hazard to be a Fleet Defect. The Contractor shall be responsible to furnish, install and replace all defective units.

Exceptions to Fleet Defect Provisions
The Fleet Defect warranty provisions shall not apply to Agency-supplied items, such as radios, fare collection equipment, communication systems and tires. In addition, Fleet Defects shall not apply to interior and exterior finishes, hoses, fittings and fabric.

Repair Procedures

Repair Performance
The Contractor is responsible for all warranty-covered repair Work. To the extent practicable, the Agency will allow the Contractor or its designated representative to perform such Work. At its discretion, the Agency may perform such Work if it determines it needs to do so based on transit service or other requirements. Such Work shall be reimbursed by the Contractor.

Repairs by the Contractor
If the Agency detects a Defect within the warranty periods defined in this section, it shall, within thirty (30) days, notify the Contractor’s designated representative. The Contractor or its designated representative shall, if requested, begin Work on warranty-covered repairs within five calendar days after receiving notification of a Defect from the Agency. The Agency shall make the bus available to complete repairs timely with the Contractor’s repair schedule.

The Contractor shall provide at its own expense all spare parts, tools and space required to complete repairs. At the Agency’s option, the Contractor may be required to remove the bus from the Agency’s property while repairs are being affected. If the bus is removed from the Agency’s property, repair procedures must be diligently pursued by the Contractor’s representative.

Repairs by the Agency

Parts Used
If the Agency performs the warranty-covered repairs, it shall correct or repair the Defect and any Related Defects utilizing parts supplied by the Contractor specifically for this repair. At its discretion, the Agency may use Contractor-specified parts available from its own stock if deemed in its best interests.

Contractor-Supplied Parts
The Agency may require that the Contractor supply parts for warranty-covered repairs being performed by the Agency. Those parts may be remanufactured but shall have the same form, fit and function, and warranty. The parts shall be shipped prepaid to the Agency from any source selected by the Contractor within fourteen (14) days of receipt of the request for said parts and shall not be subject to an Agency handling charge.

Defective Component Return
The Contractor may request that parts covered by the warranty be returned to the manufacturing plant. The freight costs for this action shall be paid by the Contractor. Materials should be returned in accordance with the procedures outlined in “Warranty Processing Procedures.”
**Failure Analysis**

The Contractor shall, upon specific request of the Agency, provide a failure analysis of Fleet Defect or safety-related parts, or major components, removed from buses under the terms of the warranty that could affect fleet operation. Such reports shall be delivered within 60 days of the receipt of failed parts.

**Reimbursement for Labor and Other Related Costs**

The Agency shall be reimbursed by the Contractor for labor. The amount shall be determined by the Agency for a qualified mechanic at a straight time wage rate of $45.00 per hour, which includes fringe benefits and overhead adjusted for the Agency’s most recently published rate in effect at the time the Work is performed, plus the cost of towing the bus if such action was necessary and if the bus was in the normal service area. These wage and fringe benefit rates shall not exceed the rates in effect in the Agency’s service garage at the time the Defect correction is made.

**Reimbursement for Parts**

The Agency shall be reimbursed by the Contractor for defective parts and for parts that must be replaced to correct the Defect. The reimbursement shall be at the current price at the time of repair and shall include taxes where applicable, plus fifteen (15) percent handling costs. Handling costs shall not be paid if part is supplied by Contractor and shipped to Agency.

**Reimbursement Requirements**

The Contractor shall respond to the warranty claim with an accept/reject decision including necessary failure analysis no later than sixty (60) days after the Agency submits the claim and defective part(s), when requested. Reimbursement for all accepted claims shall occur no later than sixty (60) days from the date of acceptance of a valid claim. The Agency may dispute rejected claims or claims for which the Contractor did not reimburse the full amount. The parties agree to review disputed warranty claims during the following quarter to reach an equitable decision to permit the disputed claim to be resolved and closed. The parties also agree to review all claims at least once per quarter throughout the entire warranty period to ensure that open claims are being tracked and properly dispositioned.

**Warranty after Replacement/Repairs**

If any component, unit or subsystem is repaired, rebuilt or replaced by the Contractor or by the Agency with the concurrence of the Contractor, the component, unit or subsystem shall have the unexpired warranty period of the original. Repairs shall not be warranted if the Contractor-provided or authorized parts are not used for the repair, unless the Contractor has failed to respond within five days, in accordance with “Repairs by the Contractor.”

If an item is declared to be a Fleet Defect, the warranty stops with the declaration of the Fleet Defect. Once the Fleet Defect is corrected, the item(s) shall have three (3) months or remaining time and/or miles of the original warranty, whichever is greater. This remaining warranty period shall begin on the repair/replacement date for corrected items on each bus if the repairs are completed by the Contractor or on the date the Contractor provides all parts to the Agency.

**Warranty Processing Procedures**

The following list represents requirements by the Contractor to the Agency for processing warranty claims. One failure per bus per claim is allowed.

- bus number and VIN
- total vehicle life mileage at time of repair
- date of failure/repair
- acceptance/in-service date
• Contractor part number and description
• component serial number
• description of failure
• all costs associated with each failure/repair (invoices may be required for third-party costs):
  • towing
  • road calls
  • labor
  • materials
  • parts
  • handling
  • troubleshooting time

Forms
The Agency’s forms will be accepted by the Contractor if all of the above information is included. Electronic submittal may be used if available between the Contractor and Agency.

Return of Parts
When returning defective parts to the Contractor, the Agency shall tag each part with the following:

• bus number and VIN
• claim number
• part number
• serial number (if available)

Timeframe
Each claim must be submitted no more than thirty (30) days from the date of failure and/or repair, whichever is later. All defective parts must be returned to the Contractor, when requested, no more than forty-five (45) days from date of repair.

(Reserved)
SECTION 8: QUALITY ASSURANCE

Contractor’s In-Plant Quality Assurance Requirements

Quality Assurance Organization

Organization Establishment

The Contractor shall establish and maintain an effective in-plant quality assurance organization. It shall be a specifically defined organization and should be directly responsible to the Contractor’s top management.

Control

Persons performing the work shall be responsible for the quality of their work. Quality control steps shall be incorporated in work instructions in manufacturing to insure all phases of production from initiation of design through manufacture and preparation for delivery.

Quality Assurance Manual

No less than thirty (30) days prior to the beginning of bus manufacture, the Contractor shall submit their Quality Assurance Manual to CATS for review and approval. CATS may audit the Contractor for compliance to their Quality Assurance Program up to fifteen (15) days prior to the beginning of bus manufacture, during manufacture, and until close of the contract. CATS may waive the audit if the Contractor is ISO-9001 certified.

Authority and Responsibility

Procedures shall be in place for employees to bring to the attention of management any situation or nonconformance that could be detrimental to the quality of transit buses. The quality assurance organization shall have the authority for acceptance or rejection of materials and manufactured articles in the production of the transit buses.

Quality Assurance Organization Functions

Minimum Functions

The quality assurance organization shall include the following minimum functions:

- **Work instructions:** The quality assurance organization shall verify inspection operation instructions to ascertain that the manufactured product meets all prescribed requirements. Work instructions and forms shall have version control.

- **Records maintenance:** The quality assurance organization shall maintain and use records and data essential to the effective operation of its program. These records and data shall be available for review by the resident inspectors. Inspection and test records for this procurement shall be available for a minimum of three (3) years after inspections and tests are completed.

- **Corrective action:** Procedures shall be in place to detect, report and promptly assure correction of any conditions that may result in the production of defective transit buses. These conditions may occur in designs, purchases, manufacture, tests or operations that culminate in defective supplies, services, facilities, technical data or standards.

Basic Standards and Facilities

The following standards and facilities shall be basic in the quality assurance process:

- **Configuration control:** The Contractor shall use the latest approved drawings, assembly procedures, and other documentation that completely describe a qualified bus that meets all of the options and special requirements of this procurement. The quality assurance program shall insure that each transit bus is manufactured in accordance with these controlled drawings, procedures, and documentation.
- **Measuring and testing facilities:** The Contractor shall provide and maintain the necessary gauges and other measuring and testing devices to verify that the buses conform to all specification requirements. These devices shall be calibrated at established periods against certified measurement standards that have known, valid relationships to national standards. The Contractor shall have a program for control of measurement and test equipment and insure that equipment is properly calibrated.

- **Production tooling as media of inspection:** When production jigs, fixtures, tooling masters, templates, patterns, and other devices are used as media of inspection, they shall be proved for accuracy at formally established intervals and adjusted, replaced, or repaired as required to maintain quality. Production Tooling must be included in the calibration program. Records of the inspections shall be maintained.

- **Equipment use by resident inspectors:** The Contractor’s gauges and other measuring and testing devices shall be made available for use by the resident inspectors to verify that the buses conform to all specification requirements. If necessary, the Contractor’s personnel shall be made available to operate the devices and to verify their condition and accuracy.

### Maintenance of Control

The Contractor shall maintain quality control of purchases:

- **Supplier control:** The Contractor shall require that each Supplier maintains a quality control program for the services and supplies that it provides. The Contractor’s quality assurance program shall identify required inspections and material tests provided by Suppliers and shall identify how conformance to specification requirements will be verified. Materials that have been inspected, tested, and approved shall be identified as acceptable to the point of use in the manufacturing or assembly processes. Controls shall be established to prevent inadvertent use of nonconforming materials. The organization shall also have procedures for oversight of Suppliers’ quality program and control of quality of supplied articles. The Contractor shall evaluate key Suppliers based on documented criteria established by the Contractor.

- **Purchasing data:** The Contractor shall verify that all applicable specification requirements are properly included or referenced in purchase orders of articles to be used on transit buses.

### Manufacturing Control

- **Controlled conditions:** The Contractor shall ensure that all basic production operations, as well as all other processing and fabricating, are performed under controlled conditions. Establishment of these controlled conditions shall be based on the documented Work instructions, adequate production equipment and special working environments if necessary.

- **Completed items:** A system for final inspection and test of completed transit buses shall measure the overall quality of each completed bus.

- **Nonconforming materials:** The quality assurance organization shall monitor the Contractor’s system for controlling nonconforming materials. The system shall include procedures for identification, segregation and disposition of nonconforming material.

- **Statistical techniques:** Statistical analysis, tests and other quality control procedures may be used when appropriate in the quality assurance processes.

- **Inspection status:** A system shall be maintained by the Contractor for identifying the inspection status of components and completed transit buses. Identification may include cards, tags or other normal quality control devices.

### Inspection System

The quality assurance organization shall establish, maintain and periodically audit a fully documented inspection system. The system shall prescribe inspection and test of materials, Work in process and completed articles. As a minimum, it shall include the following controls:

- **Inspection personnel:** Sufficient trained inspectors shall be used to ensure that all materials, components and assemblies are inspected for conformance with the qualified bus design.

- **Inspection records:** Acceptance, rework or rejection identification shall be attached to inspected articles. Articles that have been accepted as a result of approved materials review actions shall be identified.
Articles that have been reworked to specified drawing configurations shall not require special identification. Articles rejected as unsuitable or scrap shall be plainly marked and controlled to prevent installation on the bus. Articles that become obsolete as a result of engineering changes or other actions shall be controlled to prevent unauthorized assembly or installation. Unusable articles shall be isolated and then scrapped. Discrepancies noted by the Contractor or resident inspectors during assembly shall be entered by the inspection personnel on a record that accompanies the major component, subassembly, assembly, or bus from start of assembly through final inspection. Actions shall be taken to correct discrepancies or deficiencies in the manufacturing processes, procedures or other conditions that cause articles to be in nonconformity with the requirements of the Contract specifications. The inspection personnel shall verify the corrective actions and mark the discrepancy record. If discrepancies cannot be corrected by replacing the nonconforming materials, then the Agency shall approve the modification, repair or method of correction to the extent that the Contract specifications are affected.

- **Quality assurance audits:** The quality assurance organization shall establish and maintain a quality assurance audit program. Records of this program shall be subject to review by the Agency.

**Inspection**

**Inspection Stations**

Inspection stations shall be at the best locations to provide for the Work content and characteristics to be inspected. Stations shall provide the facilities and equipment to inspect structural, electrical, hydraulic and other components and assemblies for compliance with the design requirements.

Stations shall also be at the best locations to inspect or test characteristics before they are concealed by subsequent fabrication or assembly operations. These locations shall minimally include underbody structure completion, body framing completion, body prior to paint preparation, water test before interior trim and insulation installation, engine installation completion, underbody dress-up and completion, bus prior to final paint touchup, bus prior to road test and bus final road test completion.

**Resident Inspectors**

**Resident Inspector’s Role**

The Agency shall be represented at the Contractor’s plant by resident inspectors, as required by FTA. Resident inspectors may be Agency employees or outside contractors. The Agency shall provide the identity of each inspector and shall also identify their level of authority in writing. They shall monitor, in the Contractor’s plant, the manufacture of transit buses built under the procurement. The presence of these resident inspectors in the plant shall not relieve the Contractor of its responsibility to meet all of the requirements of this procurement. The Agency shall designate a primary resident inspector, whose duties and responsibilities are delineated in “Pre-Production Meetings,” “Authority” and “Pre-Delivery Tests,” below. Contractor and resident inspector relations shall be governed by the guidelines included as Attachment A to this “Section 8: Quality Assurance.”

**Pre-Production Meetings**

The primary resident inspector may participate in design review and pre-production meetings with the Agency. At these meetings, the configuration of the buses and the manufacturing processes shall be finalized, and all Contract documentation provided to the inspector.

No less than thirty (30) days prior to the beginning of bus manufacture, the primary resident inspector shall meet with the Contractor’s quality assurance manager and may conduct a pre-production audit meeting. They shall review the inspection procedures and finalize inspection checklists. The resident inspectors may begin monitoring bus construction activities two weeks prior to the start of bus fabrication.
Authority
Records and data maintained shall be available for review by the resident inspectors. Inspection and test records for this procurement shall be available for a minimum of three (3) years after inspections and tests are completed.

The Contractor’s gauges and other measuring and testing devices shall be made available for use by the resident inspectors to verify that the buses conform to all specification requirements. If necessary, the Contractor’s personnel shall be made available to operate the devices and to verify their condition and accuracy.

Discrepancies noted by the resident inspector during assembly shall be entered by the Contractor’s inspection personnel on a record that accompanies the major component, subassembly, assembly or bus from start of assembly through final inspection. Actions shall be taken to correct discrepancies or deficiencies in the manufacturing processes, procedures or other conditions that cause articles to be in nonconformity with the requirements of the Contract specifications. The inspection personnel shall verify the corrective actions and mark the discrepancy record. If discrepancies cannot be corrected by replacing the nonconforming materials, the Agency shall approve the modification, repair or method of correction to the extent that the Contract specifications are affected.

The primary resident inspector shall remain in the Contractor’s plant for the duration of bus assembly Work under this Contract. Only the primary resident inspector or designee shall be authorized to release the buses for delivery. The resident inspectors shall be authorized to approve the pre-delivery acceptance tests. Upon request to the quality assurance supervisors, the resident inspectors shall have access to the Contractor’s quality assurance files related to this procurement. These files shall include drawings, assembly procedures, material standards, parts lists, inspection processing and reports, and records of Defects.

Support Provisions
The Contractor shall provide office space for the resident inspectors in close proximity to the final assembly area. This office space shall be equipped with desks, outside and interplant telephones, Internet access, file cabinet and chairs and clothing lockers sufficient to accommodate the resident staff.

Compliance with Safety Requirements
At the time of the Pre-Production meeting, the Contractor shall provide all safety and other operational restrictions that govern the Contractor’s facilities. These issues will be discussed and the parties will agree which rules/restrictions will govern the Agency’s inspector(s) and any other Agency representatives during the course of the Contract.

Acceptance Tests
Responsibility
Fully documented tests shall be conducted on each production bus following manufacture to determine its acceptance to the Agency. These acceptance tests shall include pre-delivery inspections and testing by the Contractor and inspections and testing by the Agency after the buses have been delivered.

Pre-Delivery Tests
The Contractor shall conduct acceptance tests at its plant on each bus following completion of manufacture and before delivery to the Agency. These pre-delivery tests shall include visual and measured inspections, as well as testing the total bus operation. The tests shall be conducted and documented in accordance with written test plans approved by the Agency.

Additional tests may be conducted at the Contractor’s discretion to ensure that the completed buses have attained the desired quality and have met the requirements in Section 6: Technical Specifications. The Agency may, prior
to commencement of production, demand that the Contractor demonstrate compliance with any requirement in that section if there is evidence that prior tests have been invalidated by the Contractor’s change of Supplier or change in manufacturing process. Such demonstration shall be by actual test, or by supplying a report of a previously performed test on similar or like components and configuration. Any additional testing shall be recorded on appropriate test forms provided by the Contractor and shall be conducted before acceptance of the bus.

The pre-delivery tests shall be scheduled and conducted with sufficient notice so that they may be witnessed by the resident inspectors, who may accept or reject the results of the tests. The results of pre-delivery tests, and any other tests, shall be filed with the assembly inspection records for each bus. The underfloor equipment shall be available for inspection by the resident inspectors, using a pit or bus hoist provided by the Contractor. A hoist, scaffold or elevated platform shall be provided by the Contractor to easily and safely inspect bus roofs. Delivery of each bus shall require written authorization of the resident inspector. Authorization forms for the release of each bus for delivery shall be provided by the Contractor. An executed copy of the authorization shall accompany the delivery of each bus.

**Visual and Measured Inspections**

Visual and measured inspections shall be conducted with the bus in a static condition. The purpose of the inspection testing includes verification of overall dimension and weight requirements, that required components are included and are ready for operation, and that components and subsystems designed to operate with the bus in a static condition do function as designed.

**Total Bus Operation**

Total bus operation shall be evaluated during road tests. The purpose of the road tests is to observe and verify the operation of the bus as a system and to verify the functional operation of the subsystems that can be operated only while the bus is in motion.

Each bus shall be driven for a minimum of fifteen (15) miles during the road tests. If requested, computerized diagnostic printouts showing the performance of each bus shall be produced and provided to the Agency. Observed Defects shall be recorded on the test forms. The bus shall be retested when Defects are corrected and adjustments are made. This process shall continue until Defects or required adjustments are no longer detected. Results shall be pass/fail for these bus operation tests.

**Agency-Specific Requirements**

**Buy America**

Prior to the beginning of the bus manufacture and continuing throughout the scheduled production, the Contractor shall assist the Resident Inspector in verifying the the bus complies with Buy America domestic content requirements as specified in 49 CFR Part 661. At minimum, the Resident Inspector shall:

a. Review actual component content to ensure that the bus is manufactured with the components and materials identified in the pre-award audit; and,

b. Check that the final assembly location is in the United States and the manufacturer’s final assembly activities meet the requirements as outlined in the FTA’s Pre-Award review, as specified in Section 3.1.5.1, Buy America Certification, and as approved by the Agency prior to award.

c. The Resident Inspector must verify that the actual manufacturing processes are consistent with the information provided by the manufacturer and approved by the Agency.
ATTACHMENT A: NEW BUS MANUFACTURING INSPECTION GUIDELINES

Pre-production meeting

Responsibilities

Agency

- Provides conformed copy of technical requirements.
- Recommended staff to be involved may include the following:
  - Project manager
  - Technical engineer
  - Contract administrator
  - Quality assurance administrator
  - Warranty administrator
- Process for inspector’s role (to deal with agency) for negotiated changes after freeze date.
- Contractual requirements:
  - Milestones
  - Documentation
  - Title requirements
  - Deliverables
  - Payments
  - Reliability tracking

Manufacturer

- Identifies any open issues.
- Recommended staff to be involved may include the following:
  - Project manager
  - Technical engineer(s)
  - Contract administrator
  - Quality assurance administrator
  - Warranty administrator
- Production flow (buses/week, shifts).
- Delivery schedule and offsite component build-up schedule.
- Bus QA documentation (including supplier application approvals and/or any certifications required for the specific production).
- Communication flow/decision making.

Inspector

- Agree on decisions inspectors can and cannot make.
- Primary contact for problems, etc.
- Production flow process (description of manufacturing by station).
- Factory hours (manage inspection schedule based on production hours).
- Plant rules.
- Safety requirements.
- Orientation requirements.
- Work environment.
- Inspector’s office space (per contract).

NOTE: As a result of this meeting, documentation should be produced detailing final production requirements and the planned configuration of the bus.
**Build schedule**

The bus manufacturer’s contract administrator shall supply a fleet build production schedule based on the dates in the Notice to Proceed, and a description of the manufacturer’s schedule for plant operations.

The production schedule should contain specific milestone dates, such as:

- First vehicle on production line (date on which any work will begin);
- First vehicle off production line;
- First vehicle through manufacturer’s quality assurance inspections;
- First vehicle shipped to the agency;
- Last vehicle on production line;
- Last vehicle off production line; and
- Last vehicle shipped to the agency.

**Plant tour (if meeting at OEM’s location)**

The agency will review the entire process from start to finish and review the work completed at each line station, including quality control measures.

**Prototype/pilot vehicle production**

The contractor shall conduct acceptance tests at its plant on each bus following completion of manufacture and before delivery to the agency. These pre-delivery tests shall include visual and measured inspections, as well as testing the total bus operation. The tests shall be conducted and documented in accordance with written test plans approved by the agency. The underfloor equipment shall be available for inspection by the resident inspectors, using a pit or bus hoist provided by the contractor. A hoist, scaffold or elevated platform shall be provided by the contractor to easily and safely inspect bus roofs. Delivery of each bus shall require written authorization of the primary resident inspector. Authorization forms for the release of each bus for delivery shall be provided by the contractor. An executed copy of the authorization shall accompany the delivery of each bus.

Additional tests may be conducted at the agency’s discretion to ensure that the completed buses have attained the required quality and have met the requirements in the APTA “Standard Bus Procurement Guidelines RFP,” Section 6: Technical Specifications. The agency may, prior to commencement of production, demand that the contractor demonstrate compliance with any requirement in that section if there is evidence that prior tests have been invalidated by the contractor’s change of supplier or change in manufacturing process. Such demonstration shall be by actual test, or by supplying a report of a previously performed test on similar or like components and configuration. Any additional testing shall be recorded on appropriate test forms provided by the contractor and shall be conducted before acceptance of the bus.

The pre-delivery tests shall be scheduled and conducted with 30 days’ notice so that they may be witnessed by the resident inspectors, who may accept or reject the results of the tests. The results of pre-delivery tests, and any other tests, shall be filed with the assembly inspection records for each bus.

**Visual and measured inspections**

Visual and measured inspections shall be conducted with the bus in a static condition. The purpose of the inspection testing includes verification of overall dimension and weight requirements, that required components are included and are ready for operation, and that components and subsystems designed to operate with the bus in a static condition do function as designed.
**Total bus operation**

Total bus operation shall be evaluated during road tests. The purpose of the road tests is to observe and verify the operation of the bus as a system and to verify the functional operation of the subsystems that can be operated only while the bus is in motion.

Each bus shall be driven for a minimum of 15 miles during the road tests. If requested, computerized diagnostic printouts showing the performance of each bus shall be produced and provided to the agency. Observed defects shall be recorded on the test forms. The bus shall be retested when defects are corrected and adjustments are made. This process shall continue until defects or required adjustments are no longer detected.

**Post-delivery tests**

The agency shall conduct acceptance tests on each delivered bus. These tests shall be completed within thirty (30) days after bus delivery. The purpose of these tests is to identify defects that have become apparent between the time of bus release and delivery to the agency. The post-delivery tests shall include visual inspection and bus operations.

Buses that fail to pass the post-delivery tests are subject to non-acceptance. The agency shall record details of all defects on the appropriate test forms and shall notify the contractor of non-acceptance of each bus within five (5) days after completion of the tests. The defects detected during these tests shall be repaired according to procedures defined in the contract.

**Prototype/pilot vehicle acceptance**

In order to assess the contractor’s compliance with the Technical Specifications, the agency and the contractor shall, at the pre-production meeting, jointly develop a Configuration and Performance Review document for review of the pilot vehicle. This document shall become part of the official record of the pre-production meeting.

Potential dimensional/performance tests that may be included in the Configuration and Performance Review include the following:

- Complete electrical system audit
- Dimensional requirements audit
- Seating capacity
- Water test
- Water runoff test
- Function test of systems/subsystems and components
- Sound/noise level tests
- Vehicle top speed
- Acceleration tests
- Brake stop tests
- Airflow tests
- PA function tests
- Air/brake system audit
- Individual axle weight
- Standee capacity
- Body deflection tests
- Silent alarm function test
- Interior lighting
- Exterior lighting
- Gradability test
- Kneeling system function
- HVAC pulldown/heat
- Speedometer
- Outside air infiltration (smoke)
- Wheelchair ramps
- Engine performance qualification
  This test shall be jointly conducted by the contractor and engine manufacturer (including but not limited to charge air cooler performance, air to boil test, loss of coolant, fuel system electrical inputs and engine protection system).
- Transmission performance qualifications
  This test shall be jointly conducted by the Contractor and transmission manufacturer (including but not limited to retarder operation, heat exchanger, interface with ABS and electrical inputs).

**Buy America audit**
A post-delivery Buy America audit is required for federally funded bus procurements (see 49 CFR Part 663 for additional information). The onsite resident inspectors are to monitor the production processes to verify compliance with final assembly requirements identified by the Buy America pre-award audit. This audit is to verify compliance with final assembly requirements and final documentation of Buy America compliance and must be completed prior to title transfer.

**Resident inspection process for serial production**

**Inspector responsibilities**
The resident inspection process for the serial production of the buses begins following the completion and acceptance of the prototype or pilot vehicle if required, or according to the serial bus production schedule. Resident inspectors should represent the agency for all build-related issues (quality, conformance, etc.). Resident inspectors can also address contractual type issues but should only do so under the consult of the agency’s contracts administrator. Resident inspectors are sent to the manufacturer’s facility according to a Resident Inspection Schedule. Typically, one or two inspectors arrive on site at the manufacturing facility about one week prior to actual production to set up the resident inspection process and to begin preliminary quality assurance inspections for items such as power plant build-up and wire harness production, and to inspect incoming parts, fasteners, fluids, etc., that will be used in the production of the buses. During the serial production of the buses, the resident inspectors should monitor the production of each bus, verifying the quality of materials, components, sub-assemblies and manufacturing standards. In addition, the configuration of each vehicle should be audited using the vehicle manufacturer’s Build Specification and other documents to ensure contract compliance and uniformity.

**Inspector rotation/scheduling**
During the resident inspection phase, a single inspector or multiple inspectors could be used. If it is decided to use multiple inspectors, then the inspectors could be rotated on a biweekly to monthly basis as required. During the rotation of inspectors, a sufficient period of overlap should be provided to guarantee the consistency of the resident inspection process.

**Resident inspector orientation**
A resident inspector orientation by the bus manufacturer should take place upon the arrival of the initial inspection team. The orientation should include expectations for the use of personal protective equipment (safety shoes, safety glasses, etc.), daily check-in and check-out requirements, lines of communication, use of production documents such as speed memos and line movement charts, inspector/production meetings, inspector office arrangements, and anything else pertinent to the inspection team’s involvement during the build. Many of the above items should already be formalized during the pre-production meeting.
Audits, inspections and tests

The resident inspection process monitors the production of each vehicle. Inspection stations should be strategically placed to test or inspect components or other installations before they are concealed by subsequent fabrication or assembly operations. These locations typically are placed for the inspection of underbody structure, body framing, electrical panels and harnesses, air and hydraulic line routings, installation of insulation, power plant build-up and installation, rust inhibitor/undercoating application, floor installation, front suspension alignment, and other critical areas.

Vehicle inspections

Each bus is subjected to a series of inspections after the bus reaches the point of final completion on the assembly line. Typically, the vehicle manufacturer performs its own quality assurance inspections following assembly line completion before releasing each bus to the resident inspectors. The inspections for each vehicle are documented, signed off upon passing and included in the vehicle record.

These are the typical inspections performed on each bus by the resident inspectors:

- Water test inspection
- Road test inspection
- Interior inspection (including functionality)
- Hoist/undercarriage inspection
- Exterior inspection (including roof)
- Electrical inspection
- Wheelchair ramp/lift inspection

Water test inspection

The water test inspection checks the integrity of the vehicle’s body seams, window frame seals and other exterior component close-outs for their ability to keep rainwater, road splash, melting snow and slush, and other exterior water from entering the inside of the vehicle. The vehicle’s interior is inspected for signs of moisture and water leaks. To perform the leak inspection, interior ceiling and side panels are removed, and access doors are opened. If any moisture or water is detected, then the source of the leak will be located and repaired by the manufacturer, and the vehicle will be tested again.

Road test inspection

The road test inspection checks all the vehicle’s systems and sub-systems while the vehicle is in operation. Typically, the road test inspection is performed immediately following the water test inspection to reveal any standing water that may be present due to a leak, but was not noticed during the “static” water test. Objectionable vibrations, air leakage and other factors that affect ride quality are recorded and reported to the vehicle manufacturer for resolution. Vehicle stability, performance, braking and interlock systems, HVAC, and other critical areas are checked to ensure that the vehicle is complete and ready to provide safe and reliable service.

The following tests may be performed and recorded during the road test:

- Acceleration test
- Top speed test
- Gradability test
- Service brake test
- Parking brake test
- Turning effort test
- Turning radius test
- Shift quality
- Quality of retarder or regenerative braking action
During the road test, a vehicle may be taken to a weigh station to record the vehicle’s front axle weight, rear axle weight and total vehicle (curb) weight.

**Interior inspection**

The interior inspection checks the fit and finish of the interior installations.

In addition, the inspection also verifies the installation and function of systems and subsystems according to the Build Specification. All systems and functions accessed from the interior are inspected for functionality, appearance and safety.

Examples of systems/functions inspected include the following:

- Interior and exterior lighting controls
- Front and rear door systems
- Flooring installation
- Passenger and operator’s seat systems
- Wheelchair securement and ramp systems
- Fire suppression system
- Electrical installations (multiplex, tell-tale wiring, panels, etc.)
- Window systems and emergency escape portals
- Operator dash/side panel controls/indicators

**Hoist/undercarriage inspection**

The hoist/undercarriage inspection checks the installation of components, wiring, air lines, presence of fluid leaks, etc., located under the vehicle. Typically, this inspection is performed following the road test. The vehicle is lifted onto a hoist or pulled over a pit for the inspection. Areas inspected are the front suspension, air bags, air line routings, electrical connections and routings, drive-train components, linkages, and any other system or component that may be prone to early failure due to inadequate installation techniques. All lines, cables, hoses, etc., are inspected for proper securement and protection to prevent rubbing, chafing or any other condition that could result in a failure. The engine/powerplant and HVAC compartments are also inspected during this time.

**Exterior inspection**

The exterior inspection checks the fit and finish of components installed on the exterior of the vehicle. Access panels are opened and accessories are inspected for proper installation. In addition, vehicle paint, graphics and proper decals are also inspected. Acceptable paint finish quality (orange peel, adhesion, etc.) should be agreed on with the vehicle manufacturer prior to production to ensure consistency of inspections.

**Electrical inspection**

The vehicle’s main electrical panels and other sub-panels are inspected for proper components, to include relays, fuses, modules, terminal strips, decals, etc. In addition, electrical harnesses are inspected for proper wiring and termination techniques, bulkhead protection, looming and other items that could result in future electrical failure. Onboard vehicle compartment schematics are verified for accuracy.

**Wheelchair ramp inspection**

The wheelchair ramp assembly is inspected for proper installation and performance. Clearances critical to the operation of the ramp are verified, and the ramp’s electrical systems are inspected to ensure appropriate wire routings and protection. The successful integration of the ramp assembly into the vehicle is verified, and the vehicle interlocks are checked during automatic and manual ramp operation.
Audits
During serial production of the bus’s quality assurance inspection, tests may be performed to ensure that the manufacturer’s quality standards are being followed. These inspection audits could be on items such as torque wrench calibrations, proper techniques for fastener installations, proper use and type of adhesives, use of correct installation drawings on the production line, etc.

Communications
The lines of communications, formal and informal, should be discussed and outlined in the pre-production meeting. As previously discussed, resident inspectors should represent the agency for all bus-build related issues (quality, conformance, etc.). Resident inspectors can relay communications addressing contractual type issues but should do so only under the consult of the agency’s contracts administrator. Actual personnel contacts for the manufacturing facility should be established during resident inspector orientation. These contacts could include quality assurance, production, material handling, engineering, and buy-off area personnel.

Documentation
The following documents/reports are typically generated during the bus build process:

- Vehicle Build Specification
- Sales Order
- Pre-production meeting notes
- Prototype and production correspondence (vehicle build file)
- Manufacturer’s Vehicle Record (Warranty file)
  - Vehicle line documents
  - Serialization documents (Warranty file)
  - Alignment verification
  - Brake testing
  - HVAC testing and checkout
  - Manufacturer’s QA checklist and signoff
- Weight Slip (Prototype & Warranty file)
- Prototype Performance Tests document (vehicle build file)
  - Acceleration Test
  - Top Speed Test
  - Gradability Test
  - Interior Noise Test A – Stationary
  - Interior Noise Test B – Dynamic
  - Exterior Noise Test A – Pull Away
  - Exterior Noise Test B – Pass-By
  - Exterior Noise Test C – Curb Idle
  - Turning Radius Test
  - Turning Effort Test
  - Parking Brake Test
  - Service Brake Test
- Vehicle Acceptance Inspections – Production (Warranty file)
  - Water Test Inspection Report
  - Road Test Inspection Report
  - Interior Inspection Report
  - Hoist/Undercarriage Inspection Report
  - Exterior Inspection Report
  - Electrical Inspection Report
  - Wheelchair Inspection Report
Vehicle release for delivery

Upon satisfactory completion of all inspection, audit and test criteria, and resolution of any outstanding issues affecting the purchase of any or all buses, proper documentation (the Release for Delivery) is signed by the designated resident inspector authorizing the bus manufacturer to deliver the vehicle to the agency’s facility, where it will undergo a post-delivery inspection process and final acceptance. The satisfactory sign-off of the Release for Delivery should complete the resident inspector’s duties for each bus. In final preparation for delivery, the bus manufacturer may request the resident inspector to do a final walk-through of the bus after it has been cleaned and prepped for shipping.

Post-delivery and final acceptance

The agency shall conduct acceptance tests on each delivered bus. These tests shall be completed within 15 days after bus delivery and shall be conducted in accordance with the agency’s written test plans. The purpose of these tests is to identify defects that have become apparent between the time of bus release and delivery to the agency. The post-delivery tests shall include visual inspection, along with a verification of system(s) functionality and overall bus operations. No post-delivery test shall apply new criteria that are different from criteria applied in a pre-delivery test.

Buses that fail to pass the post-delivery tests are subject to non-acceptance. The agency shall record details of all defects on the appropriate test forms and shall notify the contractor of acceptance or non-acceptance of each bus within five days after completion of the tests. The defects detected during these tests shall be repaired according to procedures defined in the contract after non-acceptance.

Certificate of Acceptance

- **Accepted**
- **Not accepted:** In the event that the bus does not meet all requirements for acceptance. The agency must identify reasons for non-acceptance and work with the OEM to develop a timeline of addressing the problem for a satisfactory resolution and redelivery.
- **Conditional acceptance:** In the event that the bus does not meet all requirements for acceptance, the agency may conditionally accept the bus and place it into revenue service pending receipt of contractor furnished materials and/or labor necessary to address the identified issue(s).
SECTION 9: FORMS AND CERTIFICATIONS

Proposer’s Checklist

RFP: Charlotte Area Transit System Bus Procurement Project

Package 1: Technical Proposal
- □ 1. Letter of Transmittal
- □ 2. Technical Proposal
- □ 3. Acknowledgement of Addenda
- □ 4. Contractor Service and Parts Support Data
- □ 5. Form for Proposal Deviation (without price data)
- □ 6. Vehicle Questionnaire
- □ 7. References and non-priced information (if provided by Proposer)
- □ 8. Engineering organization chart, engineering change control procedure, field modification process
- □ 9. Manufacturing facility plant layout, other contracts, staffing
- □ 10. Production schedule and other Contract commitments for the duration of this Contract.
- □ 11. Management Plan

Package 2: Price Proposal
- □ 1. Letter of Transmittal
- □ 2. Pricing Schedule (including option buses, spare parts package, engineering, manuals, training, special tools and test equipment)
- □ 3. Form for Proposal Deviation (with price data)

Package 3: Qualifications Package
- □ 1. Pre-Award Evaluation Data Form
- □ 2. A copy of the three (3) most recent audited financial statements or a statement from the Proposer regarding how financial information may be reviewed by the Agency
- □ 3. Letter for insurance
- □ 4. Proposal Form
- □ 5. All federal certifications:
  - □ Buy America
  - □ Debarment & Suspension (Prime)
  - □ Debarment & Suspension (Subs)
  - □ Non-Collusion
  - □ Lobbying
  - □ DBE Approval
  - □ FMVS Standards
  - □ Bus Testing

Package 4: Proprietary/Confidential Information Package
- □ 1. Proprietary/Confidential Information

1. There may be items in the first three packages that are included in Package 4 because they are considered to be proprietary/confidential information. When this occurs, the Proposer must note that fact in Packages 1 through 3.
**Request for Pre-Offer Change or Approved Equal**

This form must be used for requested clarifications, changes, substitutes or approval of items equal to items specified with a brand name and must be submitted as far in advance of the Due Date, as specified in “Questions, Clarifications and Omissions.”

Submit form by email (preferred) to [john.larson@charlottenc.gov](mailto:john.larson@charlottenc.gov) or in writing to:

```
RFP# 269-2020-883, Bus Procurement Project
ATTN: John Larson
Charlotte Area Transit System
600 East Fourth Street, 9th Floor
Charlotte, NC 28202
```

<table>
<thead>
<tr>
<th>Request #:</th>
<th>Proposer:</th>
<th>RFP Section:</th>
<th>Page:</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

**Questions/clarification or approved equal:**

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]
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<table>
<thead>
<tr>
<th>Agency action:</th>
<th>□ Approved</th>
<th>□ Denied</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□ See addendum</td>
<td>□ See response below</td>
</tr>
</tbody>
</table>

**Agency response:**
**Acknowledgement of Addenda**

Failure to acknowledge receipt of all addenda may cause the Proposal to be considered nonresponsive to the Solicitation. Acknowledged receipt of each addendum must be clearly established and included with the Proposal.

<table>
<thead>
<tr>
<th>Addendum No.</th>
<th>Dated</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

The undersigned acknowledges receipt of the following addenda to the documents:

<table>
<thead>
<tr>
<th>Proposer:</th>
<th>Name:</th>
<th>Title:</th>
<th>Phone:</th>
<th>Street address:</th>
<th>City, state, ZIP:</th>
</tr>
</thead>
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</tbody>
</table>

Authorized signature ______________________ Date ______________________
## Contractor Service and Parts Support Data

<table>
<thead>
<tr>
<th>Location of nearest Technical Service Representative to Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
</tr>
<tr>
<td>Address:</td>
</tr>
<tr>
<td>Telephone:</td>
</tr>
<tr>
<td>Describe technical services readily available from said representative:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location of nearest Parts Distribution Center to Agency:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name:</td>
</tr>
<tr>
<td>Address:</td>
</tr>
<tr>
<td>Telephone:</td>
</tr>
<tr>
<td>Describe the extent of parts available at said center:</td>
</tr>
</tbody>
</table>

**Policy for delivery of parts and components to be purchased for service and maintenance:**

- Regular method of shipment:
- Cost to Agency:
Form for Proposal Deviation

This form shall be completed for each condition, exception, reservation or understanding (i.e., Deviation) in the Proposal according to “Conditions, Exceptions, Reservations or Understandings.” One copy without any price/cost information is to be placed in the Technical Proposal as specified in “Technical Proposal Requirements,” and a separate copy with any price/cost information placed in the Price Proposal as specified in “Price Proposal Requirements.”

Charlotte Area Transit System Bus Procurement Project

<table>
<thead>
<tr>
<th>Deviation No.:</th>
<th>Contractor:</th>
<th>RFP section:</th>
<th>Page:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete description of Deviation:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Rationale (pros and cons):</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pricing Schedule

Name of Proposer:

Address and Telephone Contact of Proposer:

Title of Authorized Individual:

The Proposer shall use this price proposal form. If the Proposer does not submit an offer on each of the three (5) bus configurations as designated in the Technical Specifications, the Proposer shall enter “no offer” on this form in the appropriate space.

1. QUANTITY
This proposal offers the buses and equipment as specified, and is effective for a five (5) year period. The proposer agrees to deliver the determined quantity of twenty-two (21) buses in the first year of the contract. These are defined as “base” buses and are guaranteed subject to the contract terms herein and the available funding from the FTA, State, and local sources. The proposer agrees to deliver up to an additional One-Hundred and Forty-Five (188) option buses over the remaining four years. The City retains the exclusive right to exercise its option to purchase these buses in the variable quantities listed. All buses and equipment to be furnished under the contract shall be ordered by issuance(s) of a Purchase Order(s) by the City in accordance with the specifications.

2. PRICES
The City reserves the right to order buses and equipment over the five (5) year period beginning upon the date of contract award. The prices of such buses and equipment shall be at the prices quoted below.

3. DELIVERY SCHEDULE
The purpose of the identified delivery schedule is to identify the City’s desired delivery dates and the quantity of the different type buses for the first year and the subsequent years of the contract. For the first year proposers will identify an aggressive schedule that best meets the delivery dates identified here. For buses purchased under option, proposers will identify both an aggressive schedule that best meets the delivery dates and option award dates for the City to execute an option for a Notice to Proceed in order for the proposers to meet their delivery dates. Prior to exercising these options, the vendors are to be aware that the City will issue a notice to proceed by September 1st of the year prior to each option year regarding the quantities and types of buses to be purchased each option year. This date complies with the notification date the federal government provides the City regarding the level of federal funding support to support the City’s purchase of buses.
4. OPTIONAL EQUIPMENT

If there is more than one vendor that offers the product specified the Proposer should provide pricing for each product.

A security camera system consisting of a minimum of ten inputs shall be provided to monitor and record events on board the buses at all times when buses are powered on.

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Unit cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAE Hybrid Series ER w/ APS 2</td>
<td>$________________</td>
</tr>
<tr>
<td>BRT Front Style</td>
<td>$________________</td>
</tr>
</tbody>
</table>

| 40' Low Floor |  |
| --- | --- | --- |
| Year | Quantity | Base Year Bus Price |
| Year 1 - Base | 0 |  |

| 40' Suburban |  |
| --- | --- | --- |
| Year | Quantity | Base Year Bus Price |
| Year 1 - Base | 0 |  |

| 30' Low Floor |  |
| --- | --- | --- |
| Year | Quantity | Base Year Bus Price |
| Year 1 - Base | 0 |  |

| 60' Articulated |  |
| --- | --- | --- |
| Year | Quantity | Base Year Bus Price |
| Year 1 - Base | 0 |  |
BRT Plus Style $_____________________
Training $_____________________
Training Modules $__________________
$ Training Aids $__________________
Special Tooling $__________________
Drivers Protection Barrier $______________
CLIMATE COMFORT TECHNOLOGIES AIR IONIZER $______________________________

6. REQUIRED SIGNATURES – AUTHORIZED REPRESENTATIVES

IF SOLE OWNER, Sign here:  
I sign as sole owner of the business named above:______________________________________________

IF PARTNERSHIP, one or more partners sign here:  
The undersigned certify that we are partners in the business named above and that we sign this contract proposal with full authority so to do:

______________________________________________  

IF CORPORATION, two corporate officers sign here:  
The undersigned certify that they sign this contract proposal with full and proper authorization so to do:  

Corporate Name

By: ______________________________ Title: ______________________________

By: ______________________________ Title: ______________________________

Incorporated under the laws of the State of ______________________________

**IF JOINT VENTURE, officers of each participating firm sign here:**

The undersigned certify that they sign this contract proposal with full and proper authorization so to do:

Joint Venture Name composed of: ______________________________

By: ______________________________ Title: ______________________________

By: ______________________________ Title: ______________________________
Pre-Award Evaluation Data Form

NOTE: This form is to be completed and included in the Qualification Package. Attach additional pages if required.

Charlotte Area Transit System Bus Procurement Project

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>1. Name of firm:</td>
<td></td>
</tr>
<tr>
<td>2. Address:</td>
<td></td>
</tr>
<tr>
<td>3. ☐ Individual ☐ Partnership ☐ Corporation ☐ Joint Venture</td>
<td></td>
</tr>
<tr>
<td>4. Date organized:</td>
<td></td>
</tr>
<tr>
<td>State in which incorporated:</td>
<td></td>
</tr>
<tr>
<td>5. Names of officers or partners:</td>
<td>a.</td>
</tr>
<tr>
<td></td>
<td>b.</td>
</tr>
<tr>
<td></td>
<td>c.</td>
</tr>
<tr>
<td></td>
<td>d.</td>
</tr>
<tr>
<td></td>
<td>e.</td>
</tr>
<tr>
<td>6. How long has your firm been in business under its present name?</td>
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</tbody>
</table>

7. Attach as SCHEDULE ONE a list of similar current contracts that demonstrates your available capacity, including the quantity and type of bus, name of contracting party, percentage completed and expected completion date.

8. Attach as SCHEDULE TWO a list of at least three similar contracts that demonstrates your technical proficiency, each with the name of the contracting party and number and type of buses completed within the last five years.

9. Have you been terminated or defaulted, in the past five years, on any Contract you were awarded?
   ☐ Yes ☐ No
   If yes, then attach as SCHEDULE THREE the full particulars regarding each occurrence.

10. Attach as SCHEDULE FOUR Proposer’s last three (3) financial statements prepared in accordance with generally accepted accounting principles of the jurisdiction in which the Proposer is located, and audited by an independent certified public accountant; or a statement from the Proposer regarding how financial information may be reviewed by the Agency [This may require execution of an acceptable non-disclosure agreement between the Agency and the Proposer.]

11. Attach as SCHEDULE FIVE a list of all principal Subcontractors and the percentage and character of Work (Contract amount) that each will perform on this Contract.

12. If the Contractor or Subcontractor is a joint venture, submit PRE-AWARD EVALUATION DATA forms for each member of the joint venture.

The above information is confidential and will not be divulged to any unauthorized personnel.

The undersigned certifies to the accuracy of all information:

Name and title: ____________________________

Company: ____________________________

Authorized signature ____________________________ Date ____________________________
Federal Certifications
Buy America Certification
This form is to be submitted with an offer exceeding the small purchase threshold for federal assistance programs, currently set at $100,000.

Charlotte Area Transit System Bus Procurement Project

<table>
<thead>
<tr>
<th>Certificate of Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Proposer hereby certifies that it will comply with the requirements of 49 USC Section 5323(j)(2)(C), Section 165(b)(3) of the Surface Transportation Assistance Act of 1982, as amended, and the regulations of 49 CFR 661.11:</td>
</tr>
</tbody>
</table>
| Name (print): | _______________________________________________________
| Title: | _______________________________________________________
| Company: | _______________________________________________________
| Authorized signature | Date |

<table>
<thead>
<tr>
<th>Certificate of Non-Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Proposer hereby certifies that it cannot comply with the requirements of 49 USC Section 5323(j)(2)(C) and Section 165(b)(3) of the Surface Transportation Assistance Act of 1982, as amended, but may qualify for an exception to the requirements consistent with 49 USC Sections 5323(j)(2)(B) or (j)(2)(D), Sections 165(b)(2) or (b)(4) of the Surface Transportation Assistance Act, as amended, and regulations in 49 CFR 661.7.</td>
</tr>
</tbody>
</table>
| Name (print): | _______________________________________________________
| Title: | _______________________________________________________
| Company: | _______________________________________________________
| Authorized signature | Date |
Debarment and Suspension Certification for Prospective Contractor

Primary covered transactions must be completed by proposer for contract value over $25,000.

Charlotte Area Transit System Bus Procurement Project

Choose one alternative:

☐ The Proposer, ___________________________________________________, certifies to the best of its knowledge and belief that it and its principals:

1. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any federal department or agency;

2. Have not within a three-year period preceding this Proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state or local) transaction or Contract under a public transaction; violation of federal or state antitrust statutes or commission or embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

3. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state, or local) with commission of any of the offenses enumerated in Paragraph 2 of this certification; and

4. Have not within a three-year period preceding this Proposal had one or more public transactions (federal, state or local) terminated for cause or default.

OR

☐ The Proposer is unable to certify to all of the statements in this certification, and attaches its explanation to this certification. (In explanation, certify to those statements that can be certified to and explain those that cannot.)

The Proposer certifies or affirms the truthfulness and accuracy of the contents of the statements submitted on or with this certification and understands that the provisions of Title 31 USC §§ Sections 3801 are applicable thereto.

Executed in

Executed in: ______________________________________________________  (insert city and state)

Name (print): _______________________________________________________

Title: ____________________________________________________________

Company: _________________________________________________________

Authorized signature  Date
Debarment and Suspension Certification (Lower-Tier Covered Transaction)

This form is to be submitted by each Subcontractor receiving an amount exceeding $25,000.

Charlotte Area Transit System Bus Procurement Project

The prospective lower-tier participant (Proposer) certifies, by submission of this Proposal, that neither it nor its “principals” as defined at 49 CFR § 29.105(p) is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or Agency.

If the prospective Proposer is unable to certify to the statement above, it shall attach an explanation, and indicate that it has done so by placing an “X” in the following space: ______

THE PROPOSER, ____________________________________________, CERTIFIES OR AFFIRMS THE
TRUTHFULNESS AND ACCURACY OF EACH STATEMENT OF ITS CERTIFICATION AND
EXPLANATION, IF ANY. IN ADDITION, THE PROPOSER UNDERSTANDS AND AGREES THAT
THE PROVISIONS OF 31 USC §§ 3801 ET SEQ. APPLY TO THIS CERTIFICATION AND
EXPLANATION, IF ANY.

| Name (print): | ________________________________ |
| Title: | ________________________________ |
| Company: | ________________________________ |

Authorized signature ________________________________ Date ________________________________
Non-Collusion Affidavit

This affidavit is to be filled out and executed by the Proposer; if a corporation makes the bid, then by its properly executed agent. The name of the individual swearing to the affidavit should appear on the line marked “Name of Affiant.” The affiant’s capacity, when a partner or officer of a corporation, should be inserted on the line marked “Capacity.” The representative of the Proposer should sign his or her individual name at the end, not a partnership or corporation name, and swear to this affidavit before a notary public, who must attach his or her seal.

Charlotte Area Transit System Bus Procurement Project

| State of ______________________________________, County of ________________________________________________ |
| I, ________________________________________________, being first duly sworn, do hereby state that |
| (Name of Affiant) |
| I am ___________________________________________ of ______________________________________________________ |
| (Capacity) |
| (Name of Firm, Partnership or Corporation) |
| whose business is ____________________________________________________________________________________ |
| and who resides at ____________________________________________________________________________________ |
| and that _____________________________________________________________________________________________ |
| (Give names of all persons, firms, or corporations interested in the bid) |
| is/are the only person(s) with me in the profits of the herein contained Contract; that the Contract is made without |
| any connection or interest in the profits thereof with any persons making any bid or Proposal for said Work; that |
| the said Contract is on my part, in all respects, fair and without collusion or fraud, and also that no members of |
| the Board of Trustees, head of any department or bureau, or employee therein, or any employee of the Authority, |
| is directly or indirectly interested therein. |
| Signature of Affiant |
| Date |
| Sworn to before me this _______ day of _______________________, 20____. |
| Notary public |
| My commission expires |
| Seal |
Lobbying Certification
This form is to be submitted with an offer exceeding $100,000.

Charlotte Area Transit System Bus Procurement Project

The Proposer certifies, to the best its knowledge and belief, that:

1. No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of a federal department or agency, a member of the U.S. Congress, an officer or employee of the U.S. Congress, or an employee of a member of the U.S. Congress in connection with the awarding of any federal Contract, the making of any federal grant, the making of any federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment or modification thereof.

2. If any funds other than federal appropriated funds have been paid or will be paid to any person for making lobbying contacts to an officer or employee of any agency, a member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this federal Contract, grant, loan or cooperative agreement, the undersigned shall complete and submit Standard Form LLL, “Disclosure Form to Report Lobbying,” in accordance with its instruction, as amended by “Government-wide Guidance for New Restrictions on Lobbying,” 61 Fed. Reg. 1413 (1/19/96).

3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants and contracts under grants, loans and cooperative agreements) and that all subrecipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31, USC § 1352 (as amended by the Lobbying Disclosure Act of 1995). Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

THE PROPOSER, _______________________________________________________, CERTIFIES OR AFFIRMS THE TRUTHFULNESS AND ACCURACY OF EACH STATEMENT OF ITS CERTIFICATION AND DISCLOSURE, IF ANY. IN ADDITION, THE PROPOSER UNDERSTANDS AND AGREES THAT THE PROVISIONS OF 31 USC §§ 3801 ET SEQ. APPLY TO THIS CERTIFICATION AND DISCLOSURE, IF ANY.

Name (print): __________________________________________________________

Title: __________________________________________________________________

Company: __________________________________________________________________

___________________________________________ ____________________________
Signature Date

Per paragraph 2 of the included form Lobbying Certification, add Standard Form–LLL, “Disclosure Form to Report Lobbying,” if applicable.
Certificate of Compliance with Bus Testing Requirement

Charlotte Area Transit System Bus Procurement Project

The undersigned certifies that the vehicle offered in this procurement complies and will, when delivered, comply with 49 USC § 5323(c) and FTA’s implementing regulation at 49 CFR Part 665 according to the indicated one of the following three alternatives.

Mark one and only one of the three blank spaces with an “X.”

1. _____ The buses offered herewith have been tested in accordance with 49 CFR Part 665 on ____________ (date). If multiple buses are being proposed, provide additional bus testing information below or on attached sheet. The vehicles being sold should have the identical configuration and major components as the vehicle in the test report, which must be submitted with this Proposal. If the configuration or components are not identical, then the manufacturer shall provide with its Proposal a description of the change and the manufacturer’s basis for concluding that it is not a major change requiring additional testing. If multiple buses are being proposed, testing data on additional buses shall be listed on the bottom of this page.

2. _____ The manufacturer represents that the vehicle is “grandfathered” (has been used in mass transit service in the United States before October 1, 1988, and is currently being produced without a major change in configuration or components), and submits with this Proposal the name and address of the recipient of such a vehicle and the details of that vehicle’s configuration and major components.

3. _____ The vehicle is a new model and will be tested and the results will be submitted to the Agency prior to acceptance of the first bus.

The undersigned understands that misrepresenting the testing status of a vehicle acquired with federal financial assistance may subject the undersigned to civil penalties as outlined in the Department of Transportation’s regulation on Program Fraud Civil Remedies, 49 CFR Part 31. In addition, the undersigned understands that FTA may suspend or debar a manufacturer under the procedures in 49 CFR Part 29.

Company name:

Name and title of the proposer’s authorized official:

________________________________________________________________________               _______________________
Authorized signature                                                                                                                              Date
DBE Approval Certification

Charlotte Area Transit System Bus Procurement Project

Certificate of Compliance

I hereby certify that the Proposer has complied with the requirements of 49 CFR 26, Participation by Disadvantaged Business Enterprises in DOT Programs, and that its goals have not been disapproved by the Federal Transit Administration.

Name (print): _______________________________________________________
Title: ____________________________________________________________
Company: _________________________________________________________

Authorized signature ___ Date ___
Federal Motor Vehicle Safety Standards

Charlotte Area Transit System Bus Procurement Project

<table>
<thead>
<tr>
<th>Certificate of Compliance</th>
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<tbody>
<tr>
<td>The Proposer and (if selected) Contractor shall submit (1) manufacturer’s FMVSS self-certification sticker information that the vehicle complies with relevant FMVSS or (2) manufacturer’s certified statement that the contracted buses will not be subject to FMVSS regulations.</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Name <em>(print)</em>:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Title:</td>
<td></td>
</tr>
<tr>
<td>Company:</td>
<td></td>
</tr>
</tbody>
</table>

Authorized signature ______________________ Date ______________________
Other Certifications
Proposal Form
Proposer shall complete the following form and include it in the price Proposal.

Charlotte Area Transit System Bus Procurement Project

PROPOSAL
By execution below by a duly authorized representative(s) of the Proposer, the Proposer hereby offers to furnish equipment and services as specified in its Proposal submitted to The Charlotte Area Transit System in response to Request for Proposal No. 269-2020-883 in its entirety.

Proposer: ________________________________________________________________

Street address: __________________________________________________________

City, state, ZIP: _________________________________________________________

Name and title of Authorized Signer(s): ____________________________________

Name and title of Authorized Signer(s): ____________________________________

Phone: __________________________________________________________________

________________________________________________________________________
Authorized signature                                                                                                                                         Date

________________________________________________________________________
Authorized signature                                                                                                                                         Date
(Reserved)
**Vehicle Questionnaire**

This form must be completed for each bus type proposed and included in the Technical Proposal.

**GENERAL DATA SHEET**

<table>
<thead>
<tr>
<th>BUS TYPE:</th>
<th>30' Low-Floor Urban Transit</th>
<th>Diesel</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(CHECK ONE VEHICLE AND ONE PROPULSION SYSTEM)</th>
<th>40' Low-Floor Urban Transit</th>
<th>Diesel</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>40' Suburban Transit</th>
<th>Diesel</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>60 foot articulated bus</th>
<th>Diesel</th>
<th>Hybrid</th>
</tr>
</thead>
<tbody>
<tr>
<td>□</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

**Bus Manufacturer:** ____________________________________________________________

**Bus Model Number:** ____________________________________________________________

**Basic Body Construction Type:** ________________________________________________

**General Dimensions**

<table>
<thead>
<tr>
<th>Overall length</th>
<th>Over bumpers</th>
<th>feet</th>
<th>inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Over body</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall width</td>
<td>Over body excluding mirrors and lights</td>
<td>feet</td>
<td>inches</td>
</tr>
<tr>
<td></td>
<td>Over body including mirrors</td>
<td>feet</td>
<td>inches</td>
</tr>
<tr>
<td></td>
<td>Over tires</td>
<td>feet</td>
<td>inches</td>
</tr>
<tr>
<td>Overall height (maximum)</td>
<td></td>
<td>feet</td>
<td>inches</td>
</tr>
</tbody>
</table>

**Angle of approach** □ degrees

**Angle of departure** □ degrees

**Breakover angle 1** □ degrees

**Breakover angle 2** □ degrees

**Doorway clear opening (at widest point)** □ inches

<table>
<thead>
<tr>
<th>Width with grab handles</th>
<th>Width without grab handles</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front door</td>
<td>inches</td>
<td>inches</td>
</tr>
<tr>
<td>Center door (1)</td>
<td>inches</td>
<td>inches</td>
</tr>
<tr>
<td>Center door (2)</td>
<td>inches</td>
<td>inches</td>
</tr>
<tr>
<td>Rear door</td>
<td>inches</td>
<td>inches</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Front axle floor height above ground (centerline of bus)</th>
<th>inches</th>
</tr>
</thead>
</table>
Center axle floor height above ground (centerline of bus) inches
Rear axle floor height above ground (centerline of bus) inches
Step height from ground (measured at center of doorway) inches

Kneeled
Front doorway inches (a)
Center doorway inches (a)
Ramp angle degrees (R1)
Rear doorway inches (a)

Unkneeled
Front doorway inches (b)
Center doorway inches (b)
Ramp angle degrees (R2)
Rear doorway inches (b)

Interior head room (floor to ceiling at center of aisle)
First axle location inches
Center of articulation inches
Rear axle location inches
Rear settee (in front of seat) inches

Aisle width
Minimum width on floor between first axle wheel housings inches
Minimum width on floor between center axle (1) wheel housings inches
Minimum width on floor between center axle (2) wheel housings inches
Minimum width on floor between rear axle wheel housings inches

Minimum ground clearance
Outside axles zones inches
Inside axles zones inches

Horizontal turning envelope (see diagram below)
Outside body turning radius, TR0 (including bumper) feet inches
Inside Body Turning Radius innermost point, TR4 (including bumper) feet inches

Wheel base
First axle to center/rear axle inches
<table>
<thead>
<tr>
<th>Component</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center axle to rear axle</td>
<td>inches</td>
</tr>
<tr>
<td><strong>Overhang, centerline of axle over bumper</strong></td>
<td></td>
</tr>
<tr>
<td>Front</td>
<td>inches</td>
</tr>
<tr>
<td>Rear</td>
<td>inches</td>
</tr>
<tr>
<td><strong>Floor</strong></td>
<td></td>
</tr>
<tr>
<td>Maximum interior floor slope (from horizontal)</td>
<td>degrees</td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
<td></td>
</tr>
<tr>
<td>Total number of passenger sittings</td>
<td></td>
</tr>
<tr>
<td>Passenger seating manufacturer/model number</td>
<td></td>
</tr>
<tr>
<td>Total number of standing passengers (1 per 1.5 sq. ft.)</td>
<td></td>
</tr>
<tr>
<td>Minimum hip to knee space</td>
<td>inches</td>
</tr>
<tr>
<td>Maximum hip to knee space</td>
<td>inches</td>
</tr>
<tr>
<td>Restraint system type and model number</td>
<td></td>
</tr>
</tbody>
</table>
### Bus weight

<table>
<thead>
<tr>
<th></th>
<th>Curb weight</th>
<th>Curb weight plus seated load*</th>
<th>GVWR</th>
</tr>
</thead>
<tbody>
<tr>
<td>First axle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Center axle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rear axle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Including operator and passengers at 150 lbs per person

### Steering Axles

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type and weight rating</th>
<th>Model number</th>
</tr>
</thead>
</table>

### Drive axle (☐ Center ☐ Rear)

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type and weight rating</th>
<th>Model number</th>
</tr>
</thead>
</table>

### Drive axle ratio

<table>
<thead>
<tr>
<th>Differential ratio</th>
<th>Hub reduction ratio (if used)</th>
<th>Final axle ratio (if hub reduction is used)</th>
</tr>
</thead>
</table>

### Brake system

<table>
<thead>
<tr>
<th>Make/type of fundamental system</th>
<th>First axle brake chamber model</th>
<th>Center axle brake chamber model</th>
<th>Rear axle brake chamber model</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>First axle slack adjuster</th>
<th>Manufacturer</th>
<th>Model number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center axle slack adjuster</td>
<td>Manufacturer</td>
<td>Model number</td>
</tr>
<tr>
<td>Rear axle slack adjuster</td>
<td>Manufacturer</td>
<td>Model number</td>
</tr>
<tr>
<td>First axle brake drum/rotor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Air compressor

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type</th>
<th>Model number</th>
<th>Rated capacity (cfm)</th>
<th>Capacity at idle (cfm)</th>
<th>Maximum warranted speed (rpm)</th>
<th>Idle speed (rpm)</th>
<th>Drive type</th>
<th>Governor cut-in pressure (psi)</th>
<th>Governor cut-out pressure (psi)</th>
</tr>
</thead>
</table>

## Air Reservoir Capacity

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Supply reservoir number and size</th>
<th>/</th>
<th>cubic inches total</th>
<th>Primary reservoir number and size</th>
<th>/</th>
<th>cubic inches total</th>
<th>Secondary reservoir number and size</th>
<th>/</th>
<th>cubic inches total</th>
<th>Parking reservoir number and size</th>
<th>/</th>
<th>cubic inches total</th>
<th>Accessory reservoir number and size</th>
<th>/</th>
<th>cubic inches total</th>
<th>Other reservoir number and size</th>
<th>/</th>
<th>cubic inches total</th>
</tr>
</thead>
</table>

## Cooling System

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Radiator</th>
<th>Charge air cooler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of tubes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fins per inch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fin thickness (inches)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fin construction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total cooling system capacity (gallons)</td>
<td></td>
<td>gallons</td>
</tr>
<tr>
<td>Radiator fan manufacturer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan speed/control type (mech/elect/hyb)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>Surge tank capacity</td>
<td>gallons</td>
<td></td>
</tr>
<tr>
<td>Surge tank material</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overheat alarm temperature</td>
<td>degrees F</td>
<td></td>
</tr>
<tr>
<td>Shutdown temperature settings</td>
<td>degrees F</td>
<td></td>
</tr>
</tbody>
</table>
## Electrical

### Primary interior lighting system
- Manufacturer
- Type
- Model number

### Alternator
- Manufacturer
- Type
- Model number
- Output at idle: **amps**

### Voltage regulator
- Manufacturer
- Model number

### Voltage equalizer
- Manufacturer
- Model number

### Auxiliary inverter (120/240)
- Manufacturer
- Model number
- Inverter technology
- Output voltage(s)

### Starter motor
- Manufacturer
- Voltage
- Model number

### Energy storage
- Batteries – low voltage
  - Manufacturer
  - Type
  - Model number
  - Cold cranking amps
- Batteries/energy storage – high voltage
  - Manufacturer
  - Type
<table>
<thead>
<tr>
<th>Model number</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy density</td>
<td></td>
</tr>
<tr>
<td>Specific power</td>
<td></td>
</tr>
<tr>
<td>Operating temperature range</td>
<td></td>
</tr>
<tr>
<td>Cooling/heating system</td>
<td></td>
</tr>
</tbody>
</table>

**Ultra-capacitor**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Model number</td>
<td></td>
</tr>
</tbody>
</table>

*Ultra-capacitor ratings: Provide data sheet for energy efficiency, estimated calendar life, cycle life, voltage (each capacitor and each module), working and peak power, and weight*

**Engine**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Model number/version</td>
<td></td>
</tr>
<tr>
<td>Horsepower/torque rating</td>
<td></td>
</tr>
</tbody>
</table>

**Fire Suppression/Methane Detection System**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Model number</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of detectors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>fire</td>
<td>methane</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type of detector</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Thermal □ Optical</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Battery backup</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Yes □ No</td>
<td></td>
</tr>
</tbody>
</table>

**Bumpers**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td></td>
</tr>
</tbody>
</table>

**Fuel and Exhaust System**

<table>
<thead>
<tr>
<th>Fuel type</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Operating range and route profile</th>
<th></th>
</tr>
</thead>
</table>

**Fuel tanks (liquid fuels)**

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Capacity (total and usable)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gallons / Gallons</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Construction material</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Quantity and location of tanks</th>
<th></th>
</tr>
</thead>
</table>

**Exhaust system**

<table>
<thead>
<tr>
<th>Diesel particulate filter manufacturer</th>
<th></th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Describe DPF electronic interface</th>
<th></th>
</tr>
</thead>
</table>
### Muffler manufacturer (if applicable)

<table>
<thead>
<tr>
<th></th>
<th>Front</th>
<th>Middle</th>
<th>Rear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Suspension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air spring manufacturer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air spring quantity per axle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock absorber manufacturer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shock absorber quantity per axle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steering</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump manufacturer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pump model number</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steering gear manufacturer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steering gear model number</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steering gear type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steering wheel diameter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum effort at steering wheel*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Unloaded stationary coach on dry asphalt pavement
<table>
<thead>
<tr>
<th><strong>Transmission / Hybrid drive system</strong> (check one)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
</tr>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Model number</td>
</tr>
<tr>
<td>Number of forward speeds</td>
</tr>
<tr>
<td>Traction motor horsepower rating</td>
</tr>
<tr>
<td>Type ventilation/cooling</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Propshaft</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Wheels</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
</tr>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Size</td>
</tr>
<tr>
<td>Mounting type</td>
</tr>
<tr>
<td>Bolt circle diameter</td>
</tr>
<tr>
<td>Protective coating</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Tires</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
</tr>
<tr>
<td>Type</td>
</tr>
<tr>
<td>Size</td>
</tr>
<tr>
<td>Load range/air pressure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Door System</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Door panels</strong></td>
</tr>
<tr>
<td>Front door</td>
</tr>
<tr>
<td>Center door (1)</td>
</tr>
<tr>
<td>Center door (2)</td>
</tr>
<tr>
<td>Rear door</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Actuating mechanism (air, electric, spring, other)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
</tr>
<tr>
<td>Front door</td>
</tr>
<tr>
<td>Center door (1)</td>
</tr>
<tr>
<td>Center door (2)</td>
</tr>
<tr>
<td>Rear door</td>
</tr>
</tbody>
</table>
### Heating and Ventilating Equipment

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating system capacity</td>
<td>Btu</td>
</tr>
<tr>
<td>Air conditioning system capacity</td>
<td>Btu</td>
</tr>
<tr>
<td>Ventilating capacity</td>
<td>CFM per passenger</td>
</tr>
<tr>
<td>Manufacturer and model</td>
<td></td>
</tr>
<tr>
<td>Refrigerant type</td>
<td></td>
</tr>
</tbody>
</table>

#### Driving heater

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>Model number</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td></td>
</tr>
</tbody>
</table>

#### Auxiliary heater

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td></td>
</tr>
<tr>
<td>Model number</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td></td>
</tr>
</tbody>
</table>

#### Floor heaters

<table>
<thead>
<tr>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td></td>
</tr>
<tr>
<td>Type/number</td>
<td></td>
</tr>
<tr>
<td>Model number</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td></td>
</tr>
</tbody>
</table>
## Passenger Loading System

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type (hydraulic, electric or both)</td>
<td></td>
</tr>
<tr>
<td>Model number</td>
<td></td>
</tr>
<tr>
<td>Capacity (lbs.)</td>
<td></td>
</tr>
</tbody>
</table>

### Dimensions

<table>
<thead>
<tr>
<th>Width of ramp</th>
<th>inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of ramp</td>
<td>inches</td>
</tr>
</tbody>
</table>

### Cycle times

<table>
<thead>
<tr>
<th>Normal idle</th>
<th>Fast idle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stowed to ground</td>
<td>seconds</td>
</tr>
<tr>
<td>Ground to stow</td>
<td>seconds</td>
</tr>
</tbody>
</table>

### Electronics

<table>
<thead>
<tr>
<th>Number of cameras</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplex system manufacturer</td>
<td></td>
</tr>
<tr>
<td>Multiplex system model number</td>
<td></td>
</tr>
<tr>
<td>Automatic passenger counter system manufacturer</td>
<td></td>
</tr>
<tr>
<td>Automatic passenger counter system model number</td>
<td></td>
</tr>
<tr>
<td>Destination sign manufacturer</td>
<td></td>
</tr>
<tr>
<td>Destination sign model number</td>
<td></td>
</tr>
<tr>
<td>AVL/AVM system manufacturer</td>
<td></td>
</tr>
<tr>
<td>AVL/AVM system model number</td>
<td></td>
</tr>
<tr>
<td>Passenger information system manufacturer</td>
<td></td>
</tr>
<tr>
<td>Passenger information system model number</td>
<td></td>
</tr>
</tbody>
</table>
Coach Body Fittings
Passenger windows manufacturer

Exterior/interior mirrors
Size
Manufacturer
Model number
Manufacturer part numbers

Bicycle racks
Manufacturer
Model number

Paint system
Manufacturer
Type

Operator control layout diagram: