

EXHIBIT B -Final Relined Specifications

SECTION 6: TECHNICAL SPECIFICATIONS

GENERAL

TS 1. Scope

Bus specifications will be for Electric Propulsion Transit/Suburban Buses, The Bus body shall have the newer look of a “BRT” styling package which includes a more rounded and curved appearance on the top, front and rear of the bus, frameless passenger windows and an extra-large two-piece windshield.

The proposed buses shall have the following priced variants;

Length: Provide a price for 40ft and 35 ft bus if offered.

Priced Configuration #1: Standard Transit bus configuration of 2 door low floor bus.

Priced Configuration #2: Suburban (1) door bus with commuter style interior layout. Padded vinyl forward facing captain’s chair commuter seating with seatbelts shall be included. USB and 110v patron outlets. Patron Wi-fi, 70mph Governor, overhead luggage storage racks (if available.) Bus shall be designed for a quiet comfortable highway ride and capable of long highway canyon grade trips. The bus shall also include an automatic tire chain system, or a prewire setup for one to be installed upon delivery

Priced Configuration #3: BRT route specific bus. Bus Shall have a ramp designed for near level platform boarding. Platform height is 12” The bus shall have streamlined large rear door to quickly allow boarding and unloading Wheelchair stations shall be priced with Quantum auto front or rear facing system (or approved equivalent). Provide pricing for one and both sides of the wheelchair securement area. The bus shall also include an automatic tire chain system, or a prewire setup for one to be installed upon delivery

Charging infrastructure/connections: Provide pricing for compatible charging infrastructure, including compatible depot chargers and high-power on route chargers. Proposed chargers will be included in the technical/delivery schedule/price scores and should meet the following requirements.

1. The successful proposer will need to demonstrate that the buses and charging equipment are fully tested and integrated. The contractor must show that the protocol on the bus is correct and matches the agency’s selected charger protocol before the buses leave the factory.
2. Proposed Charging equipment must be compatible with the Agency’s existing electric buses.
3. Proposed buses must be compatible with the Agency’s existing chargers.
4. Depot charger connections should utilize SAE J1772 DC CCS type 1
5. Overhead High-Power chargers should utilize SAE J3105, and conductors on the proposed bus shall be located towards the front of the bus.
6. Provide a standardized application protocol for communication between Electric vehicle (EV) charging stations and central management systems from different vendors to communicate with each other. The Open Charge Point Protocol (OCPP) is APPROVED.
7. Charging equipment shall include an online system where the agency can see the status of the charging equipment, pull reports/data on charger use, and diagnose problems.

8. The proposer should disclose the maximum rate of charge the proposed bus ESS can accept from the overhead charger, as well as the max output of the On-route charger, since a long-range type battery typically can't accept max output of the high-power charger
9. The agency is requesting pricing for the equipment/hardware only and is NOT soliciting design or construction costs for chargers.
10. Provide an estimated delivery date/lead-time for charging equipment from NTP. This is considered in the delivery schedule score since infrastructure can make or break the project schedule.
11. The agency will accept pricing for inductive charging options, as well as overhead depot charging options if they exist. This is for informational purposes mainly & will not be required.

Product Demo: If there is interest, the agency will entertain the idea of a bus demonstration/test from proposers. This will be on an as needed or as requested basis and is not intended for scoring purposes, but for supplementation/clarification of what is being proposed and for answering questions that may arise.

The expanded specifications are easy to recognize because they are underlined, and italicized. This paragraph is a good example of added specifications. The original specifications that are specifically not used have either been removed, or they are in their original font, black ink and have been struck through, such as this ~~example~~. Whenever a brand name of a component is mentioned, the words "or approved equal" follows the brand name even though the words "or approved equal" are not printed in the specification.

Technical specifications define requirements for heavy-duty transit buses and commuter style suburban buses ~~coaches~~, which, by the selection of specifically identified alternative configurations, may be used for both suburban, express and BRT 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.

TS 2. 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.

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 4 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).

Code: A legal requirement.

Combination Gas Relief Device: A relief device that is activated by a combination of high pressures or high temperatures, acting either independently or together.

Composite Container for CNG: A container fabricated of two or more materials that interact to facilitate the container design criteria.

Compressed Natural Gas (CNG): Mixtures of hydrocarbon gases and vapors consisting principally of methane in gaseous form that has been compressed for use as a vehicular fuel.

Container: A pressure vessel, cylinder or cylinders permanently manifolded together, used to store CNG.

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 that converts a source of direct current 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.

Defueling Port. Device that allows for vehicle defueling, or the point at which this occurs.

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 the on-vehicle system (engine/regenerative braking/ generator) or an off-vehicle energy source.

Fill Pressure for CNG: The pressure attained at the actual time of filling. Fill pressure varies according to the gas temperatures in the container, which are dependent on the charging parameters and the ambient conditions. The maximum dispensed pressure shall not exceed 125 percent of service pressure.

Flow Capacity: For natural gas flow, this is the capacity in volume per unit time (normal cubic meters/minute or standard cubic feet per minute) discharged at the required flow rating pressure.

Fuel Line: The pipe, tubing or hose on a vehicle, including all related fittings, through which natural gas 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 protruding into the standee area.

Fuel Management System: Natural gas fuel system components that control or contribute to engine air fuel mixing and metering, and the ignition and combustion of a given air-fuel mixture. The fuel management system would include, but is not limited to, reducer/regulator valves, fuel metering equipment (e.g. carburetor, injectors), sensors (e.g., main throttle, wastegate).

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 sq ft 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 Pressure: Those portions of the CNG fuel system that see full container or cylinder pressure.

High Voltage (HV): Greater than 50 V (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 engine, traction motors and energy storage system, which comprise the traction drive portion of the hybrid propulsion system.

Intermediate Pressure: The portion of a CNG system after the first pressure regulator, but before the engine pressure regulator. Intermediate pressure on a CNG vehicle is generally from 3.5 to 0.5 MPa (510 to 70 psi).

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 a crack. See *Rupture*.

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

Liner: Inner gas-tight container or gas container to which the overwrap is applied.

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 V or less (AC and DC).

Lower Explosive Limit: The lowest concentration of gas where, given an ignition source, combustion is possible.

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.

Metering Valve: A valve intended to control the rate of flow of natural gas.

Module: An 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.

Pressure Relief Device (PRD): A pressure and/or temperature activated device used to vent the container/cylinder contents and thereby prevent rupture of an NGV fuel container/cylinder, when subjected to a standard fire test as required by fuel container/cylinder standards.

NOTE: Since this is a pressure-activated device, it may not protect against rupture of the container when the application of heat weakens the container to the point where its rupture pressure is less than the rated burst pressure of the relief device, particularly if the container is partially full.

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, engine, transmission, traction motors, the hybrid drive system, (HDS), energy storage system (ESS), and system controllers including all wiring and converter/inverter.

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.

NOTE: An example is the communication that takes place between two or more electronic components with the ability to process and store information.

Service Pressure: The settled pressure at a uniform gas temperature of 21 °C (70 °F) and full gas content. It is the pressure for which the equipment has been constructed, under normal conditions. Also referred to as the nominal service pressure or working pressure.

Settled Pressure: The gas pressure when a given settled temperature, usually 21 °C (70 °F), is reached.

Settled Temperature: The uniform gas temperature after any change in temperature caused by filling has dissipated.

Solid State Alternator: A module that converts high-voltage DC to low-voltage DC (typically 12/24 V 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 referenced in “Section 6: 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 a percentage. 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 “pigtailed” commonly used to absorb flexing in piping.

Structure: The basic body, including floor deck material and installation, load-bearing external panels, structural components, axle mounting provisions and suspension beams and attachment points.

Thermally Activated Gas Relief Device: A relief device that is activated by high temperatures and generally contains a fusible material.

NOTE: Since this is a thermally activated device, it does not protect against over-pressure from improper

charging practices.

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.

TS 3. 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.

TS 4. Legal Requirements

The Contractor shall comply with all applicable federal, state and local regulations. These shall include but not be limited to ADA, as well as state and local accessibility, safety and security requirements. Local regulations are defined as those below the state level.

Buses shall meet all applicable FMVSS regulations and shall accommodate all applicable FMCSR regulations in effect at the location of the Agency and the date of manufacture.

In the event of any conflict between the requirements of these specifications and any applicable legal requirement, the legal requirement shall prevail. Technical requirements that exceed the legal requirements are not considered to conflict.

TS 5. 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.

TS 5.1 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.

TS 5.2 Capacity

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

TS 5.3 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.

TS 5.4 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~~ *charging* 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.

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 that 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 and pricing required for maintaining this equipment. Said list shall be submitted as a supplement to the Pricing Schedule.

NOTE: 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.

TS 5.5 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 changes 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 at least as well as the originally supplied products.

TS 5.6 Training

Introduction

Training Costs shall be part of the bus evaluation, but priced separately.

Contractor shall be responsible for providing the following training:

1. Training in the maintenance and operation of the contracted buses. Training materials sufficient to support continued in-house Agency's training.
2. Update training and training materials when, in the scope of the contract, changes or modifications are made that affect the operation or maintenance of the buses that are contracted through final delivery of the initial base order of buses. All subsequent training which may be requested for optional bus orders will be negotiated and priced accordingly. This deliverable section specifies the nature of the training activities and training materials that are required from the Contractor.

Scope of Work for the Maintenance and Operation's Departments

Operation's Department:

The Contractor shall have at least one qualified instructor who will be available at UTA for three continuous days between the hours of 8:00 am – 5:00 pm sometime after the acceptance of the first bus. The instructor shall conduct classes to teach UTA training staff on the proper operation of the buses as well as useful troubleshooting techniques associated with operating the bus. The Contractor shall provide sufficient operating manuals for the training staff to be used during the 2 days of training sessions. Provide an electronic copy of the operating manual to UTA for future training needs.

Maintenance Department:

Up to five (5) Maintenance Training Specialists and Maintenance Instructors, and five (5) Maintenance Supervisors shall be provided "Train the Trainer" instructions for Maintenance Procedures, as outlined below in Salt Lake City, Utah. Up to forty (40) mechanics shall be trained on the proper and recommended procedures to perform Maintenance procedures as outlined below at a UTA location to be determined by Maintenance Training and, at the discretion of UTA, be provided on more than one (1) shift (i.e. days, swing).

1. Maintenance Training will be tailored specifically to the Agency's buses, including all new technology equipment, and be designed to develop the knowledge and skills of the Maintenance Employees and Maintenance Training Specialists required to maintain the buses delivered under the contract. Maintenance Training will be provided in the following major areas:
 - a. Propulsion system (Vendor Specific)
 - b. Transmission (Vendor Specific if applicable)
 - c. Battery system
 - d. HVAC(Vendor Specific)
 - e. Passenger Door
 - f. Wheelchair ramp (R & R and Overhaul) (Vendor Specific)
 - g. Air & Brake System
 - h. Electrical System (emphasis on new technologies)

- i. *Steering/Suspension*
 - j. *Familiarization and Orientation*
 - k. *Preventive Maintenance (Contractor shall provide Inspection Sheets)*
 - l. *Body and Panel Repair*
 - m. *Tow, Service Truck procedures, and proper lifting of vehicle (specific to UTA equipment & facility).*
 - n. *Fire Suppression Systems (Vendor Specific)*
 - o. *Any new technology equipment not covered in section 2 a-m.*

- 2. *System Level Maintenance Training, covering:*
 - a. *Theory of Operation*
 - b. *Mechanical System Configuration*
 - c. *Preventive Maintenance*
 - d. *Written and Validated Inspection*
 - e. *Use of any and all special tools and equipment necessary to diagnose, troubleshoot, and repair the bus.*

- 3. *Shop Level Maintenance Training, covering:*
 - a. *Detailed Theory of operation to module, board, and/or device level.*
 - b. *Component level Troubleshoot and Replacement.*
 - c. *Testing and Alignment of repaired units.*
 - d. *Use of any and all special tools and equipment necessary to diagnose, troubleshoot, and repair the bus.*

Deliverables

Within sixty (60) days after Notice to Proceed, the Contractor will provide the Agency's Maintenance Training Department an outline of the proposed training programs for approval.

The Contractor shall submit two (2) draft copies of each deliverable for approval ninety (90) days prior to the first scheduled class. The Agency's Maintenance Training Department will coordinate and schedule all classes.

Thirty (30) days prior to the beginning of the first scheduled class, the Agency's Training Department requires the following approved course materials to be delivered by the Contractor according to the following specifications:

- 1. *Instructor's Guide to contain all the information and directions necessary for the Agency's instructors to make an effective presentation and practical demonstration. It shall include adequate guidelines to conduct a comprehensive training program. Individual lessons within the course will be organized as separate units or modules which may be taught as a unit. In some instances, the same unit could be used more than once. For example, the unit on standard operating procedures could be used to train operators, mechanics and service personnel.*

The Instructors Guide should contain, at a minimum:

- a. *A list of learner prerequisites (if any);*

- b. Program Overview;
 - c. A statement of overall program goals;
 - d. Lesson Plans that include a session by session outline containing the following:
 - 1. A Terminal Objective stated in measurable terms, defining the expected behavior of the learner at the completion of the specific session.
 - 2. Enabling Objectives identifying the specific behavior the learner must exhibit to achieve the Terminal Objective.
 - 3. Overview of each lesson.
 - 4. Suggested instructional methods/learning activities.
 - 5. Required equipment, audio/visual aids and/or other resources.
 - 6. Estimated time required for each lesson and objective.
 - e. Evaluation devices, (written and practical tests with an answer key for each of the tests developed) designed to measure the extent of Knowledge and Skill transfer that align with Terminal Objectives of courses
- 2. Learner Materials, to include all materials for the student to interact in the learning situation. It shall contain, at a minimum:
 - a. Program overview/introduction.
 - b. Statement of overall program goals.
 - c. Terminal objectives stated in measurable terms that specifically describe desired behaviors or knowledge to be gained.
 - d. Enabling Objectives identifying the specific behavior the learner must exhibit to achieve the Terminal Objective.
 - e. A fully developed prose treatment of content presentation, developed to follow the instructors guide.
 - f. Illustrations, charts, or graphics, as needed to enhance learner's retention.
 - g. Problem/questions related to lesson content, as appropriate.
- 3. Audio-visual (AV) aids shall be included for all systems listed in Scope of Work 1: a., b., c., d., e., f., g., h., i., j., k., l., m, and n. These AV aids may include: handouts, videos, online training and slide presentations (PowerPoint, Prezi, etc.).
- 4. Special Tools
 - a. The Contractor shall submit a list of equipment or tools, other than those normally found in a mechanic's tool box, necessary for the general upkeep, maintenance, and overhaul of the equipment or products contained in buses delivered under this contract. This list must contain the tool manufacturer's name and price for all specialty tools.
- 5. Supplemental Materials. A functional mock-up, or a functional representation, is required of any equipment which requires discussions. This may be in the form of a model of the equipment, actual device, an interactive video training device, or the Procuring Agency's Training Department's approved substitute. All mock-ups, training aids and audio visual supplies and equipment shall become the property of the Procuring Agency.

All Training "Deliverables" listed above, including Items 1 through 5, shall be provided upon acceptance of the last bus. If all items are not delivered with the acceptance of the last bus, the five percent (5%) retention payment on all buses will be withheld until all items are received by the Agency.

Number of Copies

The Contractor shall deliver final copies to the Agency as follows:

1. One (1) complete set of training materials that is completely camera-ready. Camera-ready is defined as typewritten or typeset originals or high quality copies such that further copies can be made with no noticeable decrease in copy quality.
2. Forty(40) copies of Learners guides and two (2) instructor guides, (maintenance courses) to be used for archival purposes in the Agency's Technical Library.
3. A complete set of all written materials, drawings, pictures, etc. shall be in electronic format (stored on DVD). The electronic format shall be written in Word or Excel. If the Contractor uses a software other than that specified, the Contractor's software shall be included.
4. All written and audio-visual training and software materials shall become the property of the Agency. The Agency reserves the right to copy any and all materials to be used in training the Agency's personnel.

Instructional Delivery

Contractor shall meet the following specifications in instructional delivery:

1. Instructor Qualifications. A description of instructor qualifications, a resume, curriculum vita, or other description of instructor qualifications must be submitted during the RFP's Approved Equals stage of the procurement. The description should document a thorough knowledge of the equipment being taught, an understanding of the adult learning process, and demonstrated experience in vocational instruction.
2. Class Size. Classes shall be limited to a maximum of ten (10) mechanics per class for Maintenance personnel.
3. Testing. Instructor must give written and practical tests as a measuring device to determine knowledge and skills transference. Tests must be pre-approved by the Agency. A practical hands-on test is required (if applicable) to measure the skills transfer of Technicians. The practical test, if provided, shall be administered by the use of a check list of each job and/or task.

TS 5.6.1 Technical/Service Representatives

The Contractor shall, at its own expense, have one or more competent technical service representatives available on request to assist the Agency in the solution of engineering or design problems within the scope of the specifications that may arise during the warranty period. This does not relieve the Contractor of responsibilities under the provisions of "Section 7: Warranty Requirements."

TS 5.7 Operating Environment

ALTERNATIVE-----APPROVED

Agency will provide temperature range.

The bus shall achieve normal operation in ambient temperature ranges of 10 °F to 115 °F, at relative humidity

between 5 percent and 100 percent, and at altitudes ~~up to 4,200 ft thru 5,200 ft~~ above sea level in urban service areas. Degradation of performance due to atmospheric conditions shall be minimized at temperatures below 10 °F, above 115 °F or at altitudes above 5200. Altitude requirements above 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.

TS 5.8 Noise

TS 5.8.1 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. Measurements of interior noise levels shall be taken in accordance with ISO 3381. An exception shall be made for the turntable area, which shall be considered a separate environment. *The Agency will accept performance at 75 dBA with A/C off and 78 dBA with A/C on at the driver's area.*

TS 5.8.2 Exterior Noise

Airborne noise generated by the bus and measured from either side shall not exceed 80 dBA under full power acceleration when operated at 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. The Contractor shall comply with the exterior noise requirements defined in local laws and ordinances identified by the Agency and SAE J366. *The Agency will accept a Curbside idle noise level of 68 dB.*

DEFAULT-----APPROVED

Noise level should be as stated.

TS 5.9 Fire Safety

The bus shall be designed and manufactured in accordance with all applicable fire safety and smoke emission regulations. These provisions shall include the use of fire-retardant/low-smoke materials, fire detection systems, bulkheads and facilitation of passenger evacuation.

TS 5.9.1 Materials

DEFAULT-----APPROVED

All materials used in the construction of the passenger compartment of the bus shall be in accordance with the Recommended Fire Safety Practices defined in FMVSS 302.

TS 5.10 Fire Suppression

DEFAULT-----APPROVED

The bus shall have a fire suppression system installed per manufacturer's recommendations.

Any proposed fire suppression system MUST be specifically designed and engineered for the ESS system that is proposed. The agency will not accept a fire suppression system designed for an internal combustion powered vehicle.

Supply and install a Fire Suppression System for bus protection. The system shall be a dry chemical or other pre-engineered fire suppression system with automatic detection and actuation.

1. System must comply with NFPA 17.
2. System shall provide 24-hour fire detection of the electric drive compartment.
3. The system shall be designed to operate at 12 or 24 VDC and shall not exceed 0.1 amp current draw.
4. The entire Fire Suppression System shall be Factory Mutual Research Corporation approved.
5. A minimum of four ambient, temperature-sensitive sensors shall be provided.
6. Sensors shall be located in the electric drive compartment under all horizontal bulkheads, above and downwind of the major heat sources, and in areas likely to be exposed to leaking flammable fluids.
7. Additional sensors shall be located in other potentially critical areas.
8. The sensors shall detect over-temperature in the critical areas and shall activate the fire alarm bell and warning light in the driver's compartment.
9. The sensors shall return to normal setting and deactivate alarms when the temperature returns to normal.
10. ~~The fire suppression system shall shut down the engine when activated.~~
11. Install the fire extinguisher Control Panel and Manual Switch in the Operator's compartment.
12. System must have self-check and manual test functions to ensure the system is operational.
13. The dry chemical bottle must be located so the gauge can be easily seen and for ease of maintenance.

TS 5.11 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. 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

TS 6. 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



TS 6.1 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.
- **35 ft bus:** 35 ft to 39 ft, 11 in.
- **40 ft bus:** 40 ft to 44 ft, 11 in.

TS 6.2 Bus Width

TS 6.2.1 Transit Coach

DEFAULT-----APPROVED

102 in. Width Bus

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

~~**TS 6.2.2 Commuter Coach**~~

TS 6.3 Bus Height

DEFAULT-----APPROVED

Maximum Overall Height

Maximum overall height shall be 140 in., including all rigid, roof-mounted items such as A/C, ~~exhaust, fuel system~~ Batteries and cover, etc.

TS 6.4 Step Height

TS 6.4.1 Transit Coach

The step height shall not exceed 16.5 in. at either doorway without kneeling and shall not exceed 15.5 in. at the step. A maximum of two steps are allowed to accommodate a raised aisle floor in the rear of the bus.

~~**TS 6.4.2 Commuter Coach**~~

~~**TS 6.4.3 Articulated Coach**~~

TS 6.5 Underbody Clearance

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

TS 6.6 Ramp Clearances with the use of Skid Plates

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.

DEFAULT-----APPROVED with the exception of front and rear Skid Plates

Refer to **Table 2a**.

TABLE 2a
 Default Breakover Angle

Angle	30 to 45 ft Bus	60 ft Bus
Approach	8.6 deg (min.)	8.6 deg (min.)
Front breakover	8 deg (min.)	10.2 deg (min.)
Rear breakover (articulated only)	n/a	8.7 deg (min.)
Departure	8.6 deg (min.)	8.6 deg (min.)

SKID PLATES:

The bus must meet the Approach and Departure Angles with the **exception** of the protective skid plates that are added to both front corners of the bus and the two skid plates at the rear of the bus.

Attach two (2) front corner skid plates securely to the bumper/bus frame members to protect under floor components from damage when scrapping the road, gutter or curb. The front skid plates shall be approximately 6-8 inches by 6-8 inches by 1/4 inch thick steel. The skid plates are to be sloped or curved downward and pointed towards the rear of the bus and extend sideways at least 1/4 to 1/2 inch past the curb-side or street-side side body panels at the front corners of the bus. The skid plates are to have a smooth surface to slide or rub against the concrete curbs or street pavement. The skid plates are approved even if they provide less than the required 8.6 degrees Approach Angle.

The Agency will accept front skid plates that are of slightly different dimensions and on the StreetSide and do not extend past the side body panel.

Attach two (2) rear skid plates to the bus frame members at the very rear of the bus. Each steel skid plate needs to be at least 2 inches wide, 2 inches thick and 6 inches long. The leading edge of the skid plate is to be curved slightly up to prevent digging into the road surface when sliding on street pavement. The skid plates are approved even if they provide less than the required 8.6 degrees Departure Angle.

TS 6.7 Ground Clearance

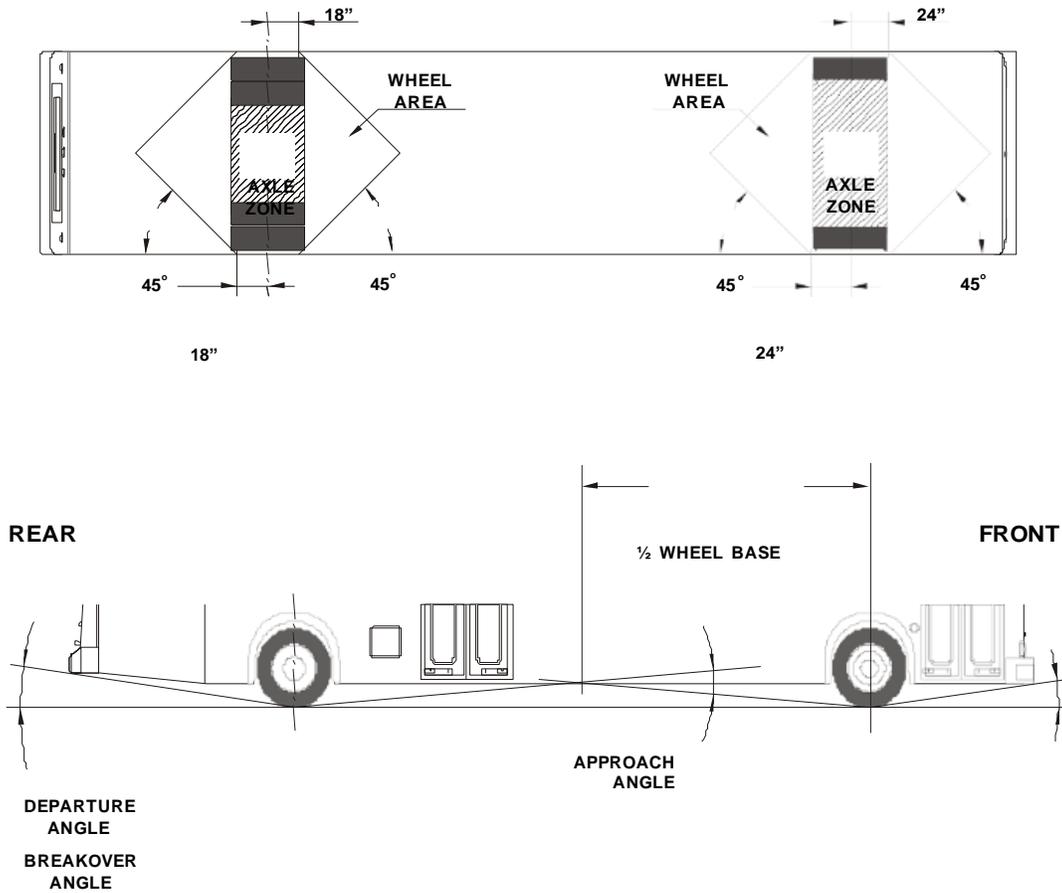
Ground clearance shall be no less than 9 in., (8 in. at jacking pad) except within the axle zone and wheel area.

Axle zone clearance, which is the projected area between tires and wheels on the same axial centerline, shall be no less than 5.4 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.

FIGURE 2

Transit Bus Minimum Road Clearance



TS 6.8 Floor Height

TS 6.8.1 Transit Coach

Height of the step above the street shall be no more than 16 in. measured at the centerline of the front and rear doorway. 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 are allowed to accommodate a raised aisle floor in the rear of the bus.

~~TS 6.8.2 Commuter Coach~~

TS 6.9 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 65 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.

VEHICLE PERFORMANCE

TS 7. 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.

The bus shall have a double wound or high output motor for canyon service at highway speeds and a min of 210kw output.

TS 7.1 Top Speed

~~ALTERNATIVE~~-----APPROVED

Agency to specify top speed limit. The bus shall be capable of achieving a top speed of 72 mph (*when and if programed*) and a governed 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.

TS 7.2 Gradability

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

~~DEFAULT~~-----APPROVED

The propulsion system shall enable the bus to achieve and maintain a speed of 45 mph on a 3 percent ascending grade and 18 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.

TS 7.3 Acceleration

TS 7.3.1 ~~Non-Hybrid Electric bus~~

The acceleration shall meet the requirements in **Table 3** below and shall be sufficiently gradual and smooth to prevent throwing standing passengers off-balance. Acceleration measurement *from idle* shall commence when the accelerator is depressed. Use the information from the engine data logger to calculate and determine the acceleration rates as found in Table 3.

TABLE 3
Maximum Start Acceleration Times on a Level Surface¹

Speed (mph)	Maximum time (seconds)
10	5
20	10
30	18
40	30
50	60
Top speed	

1. Vehicle weight = GVWR

TS 7.3.2 ~~Acceleration Hybrid Electric bus deceleration~~

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.

TS 7.3.3 ~~Acceleration (Commuter Coach)~~

TS 7.4 Operating Range

The operating range of the coach shall be designed to meet the operating profile as stated in the “Design Operating Profile” section. Operating range is subjective and dependent upon battery size. Final battery size and operating range TBD at a later time by the Agency. The bus batteries should however include a minimum of a 12 year warranty built into the base bus price.

TS 7.4.1 Diesel (Transit Coach)

TS 7.4.2 Diesel (Commuter Coach)

~~TS 7.4.3 CNG~~

TS 7.4.4 Hybrid

TS 8. Fuel Economy (Design Operating Profile)

POWERPLANT

TS 9. Engine

~~TS 9.1 Engine (CNG)~~

~~TS 9.2 Propulsion System (Hybrid)~~

~~TS 9.2.1 Propulsion System Description~~

~~TS 9.2.2 Propulsion System Service~~

~~TS 9.2.3 Primary Propulsion Unit and Traction Motor~~

~~TS 9.2.4 Energy Storage and Controller~~

~~TS 9.2.5 Hybrid System Controller (HSC)~~

~~TS 9.2.6 Engine~~

ALTERNATIVE-----APPROVED

Agency shall define required powerplant. Propulsion system

The engine Propulsion system shall be equipped with an electronically controlled management system, compatible with multiplex wiring systems and either 12 or 24 V electrical systems.

The engine Propulsion system shall have on-board diagnostic capabilities, be 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 the operator's area and near or inside the electric drive 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.

TS 10. Cooling Systems

The cooling systems *if applicable for electric propulsion* shall be of sufficient size to maintain all engine and transmission fluids and engine intake air *propulsion drive components* at safe, continuous operating temperatures during the most severe operations possible and in accordance with engine and transmission *propulsion drive* manufacturers' cooling system requirements. The cooling system fan controls should sense the temperatures of the operating fluids and *any temperature critical components (electrical boxes ect.)* 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.

TS 10.1 Engine Cooling System Requirements, Electric Fan, Coolant, Coolant Sample Test Port

If applicable for Electric Propulsion, 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. Provide a means for checking coolant level whether the vehicle is hot or cold

Minimum Ambient Cooling Capacity of 110 °F ** at 5,000 ft. Elevation

If applicable for Electric Propulsion, The cooling system in new condition is required to have a minimum Ambient Cooling Capacity of at least 110 °F using a 50/50 mix of antifreeze and water as coolant, while operating at 5,000 feet above sea level at GVW. A brand new bus cooling system meeting the above Ambient Cooling Capacity of 110°F with 50/50 coolant, at 5,000 ft. altitude will perform at a minimum Ambient Cooling Capacity of 123°F at sea level (from 0 to 500 ft. above sea level).

** Actual maximum summer temperature is more like 105°F. After 3 or more years in bus transit use, the degradation of the cooling system would perform more like it was 110 °F.

Ambient cooling capacity figure notes:

- Start at 500 ft. above sea level. Add an average 3°F per 1000 ft. rise in elevation, which equals to 13.5°F less cooling capacity at 5,000 ft (almost the highest point of the Authority's **urban** service area) than at sea level.
- When the 13.5°F is added to the minimum specification of 110°F, the total equals the required minimum Ambient Cooling Capacity of just over 123°F at sea level.

The proposer shall provide detailed test and evaluation reports showing how the electric fan cooling system was determined to meet the minimum Required Ambient Cooling Capacity of 110°F at 5,000 ft. elevation.

DEFAULT

The radiator and charge air cooler shall be of durable, corrosion-resistant construction with non-removable tanks.

ALTERNATIVE----- APPROVED

If applicable for electric propulsion. The radiator and charge air cooler shall be of durable, corrosion-resistant construction with non-removable radiator headers.

*Add Corrosion Resistant Epoxy (E-Coat) to the entire exterior of the radiator and charge air cooler by the dipping process. Provide a strong, cross braced, if necessary, radiator core made totally of aluminum; lead free solder inside and out, with reinforced tubes and core corners. Provide solid fins made out of aluminum with the leading and trailing edges folded and crimped with a maximum of 10 fins per inch. Hump hoses are to be installed on the radiator inlet and outlet. **The Agency requests this be a part of the base bus price.***

The threads of all bolts/nuts that are used to mount the Radiator shall be coated with anti-seize.

TS 10.1.1 Radiator Screen

ALTERNATIVE-----APPROVED

Screen in Front of Radiator

The radiator input shall be protected by an easily cleanable screen designed to collect large debris. Radiators with a fin density greater than ~~12~~ **10** fins per inch or a louvered slit design shall not be used. ~~No heat-producing components or climate control system components shall be mounted between the engine cooling air intake aperture and the radiator.~~ The radiator and charge air cooler shall be designed to withstand thermal fatigue and vibration associated with the installed configuration. The radiator and charge air cooler cores shall be easily cleaned (to include engine side core surface) with standard pressure-washing equipment.

TS 10.1.2 Coolant

DEFAULT-----APPROVED

Standard Requirement for Coolant Filtration

If applicable for Electric Propulsion ,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 (*Nitrite/Borate Chemistry*) as needed to replenish and maintain protection properties. When replacing the water filter, only the water in the filter will be lost. *Use ¼ turn brass valves rated at 150 psi on each side of the coolant filter. Gate valves are not approved for any reason, anywhere on the bus.*

Engine Coolant

If applicable for Electric Propulsion ,Provide a fully formulated (Nitrite/Borate Chemistry) antifreeze from virgin antifreeze that is phosphate free, low silicone, ethylene glycol base, mixed with de-ionized or vacuum distilled water in a 50/50 water and antifreeze blend. Coolant shall meet the minimum Cummins Engineering Standard 14603.

Install a heavy duty push button valve from the coolant outlet to take coolant samples.

Location TBD.

The “Checkfluid KP18NV” sample valve has been **APPROVED**.

Old World Industries FLEET CHARGE® coolant has been APPROVED

TS 10.1.3 Drive Design

ALTERNATIVE-----APPROVED

Electric Fans

The bus shall be equipped with an electric fan drive bus cooling system. A screen guard must be installed on electric motor fans per SAE J1308.

ALTERNATIVE-----APPROVED

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~~.

If applicable for Electric Propulsion provide an electric cooling fan system with electronic controls:

- The system shall be constructed completely of lightweight materials.
- The fan system shall have the ability to separately cool the radiator using J1939 information.
- The fan system shall have the ability to vary fan speeds according to the coolant and electrical component cooling needs
- The entire electric fan system shall be sealed from the elements to prevent corrosion and premature failure.
- The system shall fully shut down in the event of a fire.
- The fans used shall have guards to prevent finger injury by accidental insertion.

TS 10.1.4 Mounting

DEFAULT-----APPROVED

Standard Mounting Design

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

TS 10.2 Charge Air Cooling

TS 10.3 Transmission Cooling

TS 10.4 Hybrid-Propulsion Drive System Cooling

The thermal management system shall maintain hybrid drive system components within design operating temperature limits.

TS 11. Transmission (Conventional Powertrain)

*-If bus is equipped with a mechanical transmission with oil, provide a transmission oil sampling valve on a pressurized flow through oil line, or approved equal. Care should be taken to minimize the length of the line that feeds the sampling valve. **Location TBD.***

*The "Checkfluid KP18NV" sampling valve has been **APPROVED.***

ALTERNATIVE-----APPROVED

A nominal brake pedal application of 15 to 20 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.

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

ALTERNATIVE-----APPROVED

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.

The transmission shall have the ability to travel 48,000 miles between oil changes, in transit service, when using approved synthetic transmission oil.

TS 12. Retarder (Transit Coach)

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~~*A hydraulic retarder application gauge is not required for the Vansco Multiplex Instrument cluster.*~~

TS 13. Engine Brake (Commuter Coach)

TS 14. Mounting

All ~~powerplant~~ drivetrain mounting shall be mechanically isolated to minimize transfer of vibration to the body structure and provide a minimum clearance of 0.75 in. Mounts shall control the movement of the ~~powerplant~~ drivetrain so as not to affect performance of belt-driven accessories or cause strain in piping and wiring connections to the ~~powerplant~~ drivetrain.

TS 14.1 Service

The propulsion system shall be arranged for ease of access and maintenance. The Contractor shall list all special tools, fixtures or facility requirements recommended for servicing. ~~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 Electric Propulsion drive engine and transmission removal. ~~An engine oil pressure gauge and~~ If applicable for Electric Propulsion, A coolant temperature gauge shall be provided in the electric drive 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.

TS 15. Hydraulic Systems

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.

Provide a service port on the steering gear for testing hydraulic pressure and flow.

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

~~ALTERNATIVE~~-----APPROVED

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.

TS 15.1 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.

Add split plastic conduit over all flexible hoses that carry fluids and air located in the electric drive compartment, a/c compartment and under the bus. Flexible hoses that are adequately clamped to ensure that there is no chaffing and when hoses are routed close to the heat source adequate protection is provided is Approved without split plastic conduit.

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.

TS 15.2 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 electric drive compartment, resistant to road salts near the road surface, and so on).

*Oetiker and Breeze clamps have been **APPROVED**.*

*Ideal constant torque clamps have been **APPROVED***

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.

TS 15.3 Charge Air Piping

TS 16. Radiator

Radiator piping shall be stainless steel, brass tubing or painted steel rated at 1000 hours of salt spray according to ASTM B117 and where practicable, hoses shall be eliminated, including biodiesel. Necessary hoses shall be impervious to all bus fluids. All hoses shall be secured with stainless steel clamps that provide a complete 360 deg 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.

TS 17. 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 electric drive compartment, resistant to road salts near the road surface and so on). Lines within the electric drive compartment shall be composed of steel tubing where practicable, except in locations where flexible lines are required.

*Add split plastic conduit over all flexible hoses that carry fluids and air located in the electric drive compartment, a/c compartment and under the bus. **Flexible hoses that are adequately clamped to ensure that there is no chaffing and when hoses are routed close to the heat source adequate protection is provided is Approved without split plastic conduit.***

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.

TS 18. Fuel

TS 19. Emissions and Exhaust

STRUCTURE

TS 20. General

TS 20.1 Design

The structure of the bus shall be designed to withstand the transit service conditions typical of an urban or intercity 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.

TS 21. 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 that any and all such failures will not occur shall be submitted to the Agency.

DEFAULT-----APPROVED

If available, The Altoona Test Report shall be provided to the Agency with the Proposal submittal. If not available, then the report shall be provided prior to first acceptance of bus.

TS 21.1 Structural Validation

DEFAULT-----APPROVED

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~~ **and** finite element analysis (FEA).

TS 22. 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.

TS 23. 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.

TS 23.1 Electric drive compartment Bulkheads

The passenger and engine ***Electric Propulsion*** compartment shall be separated by fire-resistant bulkheads. ~~The electric drive compartment shall include areas where the engine and exhaust system are housed. This~~

bulkhead shall preclude or retard propagation of ~~an electric drive 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~~ Electric Propulsion 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.

TS 23.2 Crashworthiness (Transit Coach)

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 lb automobile at any side, excluding doorways, along either side of the bus and the articulated joint, if applicable, 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 35 in. from ground level shall withstand a static load of 2000 lbs applied perpendicular to the bus 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.

TS 24. Corrosion

The bus flooring, sides, roof, understructure and axle suspension components shall be designed to resist corrosion or deterioration from atmospheric conditions and de-icing materials for a period of 12 years or 500,000 miles, whichever comes first. It shall maintain structural integrity and nearly maintain original appearance throughout its service life, with the Agency's use of proper cleaning and neutralizing agents.

All materials that are not inherently corrosion resistant shall be protected with corrosion-resistant coatings. All joints and connections of dissimilar metals shall be corrosion resistant and shall be protected from galvanic corrosion. Representative samples of all materials and connections shall withstand a two-week (336-hour) salt spray test in accordance with ASTM Procedure B-117 with no structural detrimental effects to normally visible surfaces and no weight loss of over 1 percent.

ALTERNATIVE-----APPROVED

Corrosion Resistance Requirements

All exposed surfaces and the interior surfaces of tubing and other enclosed members below and above the lower window line shall be corrosion resistant through application of a corrosion protection system.

The following is the procedure that shall be followed when using non-inherently corrosion resistant material for

the main structure:

Surface Preparation:

After the bus frame has been welded together, it must be prepped before applying corrosion protection. This involves several processes to adequately protect the structure from premature corrosion.

1. All bus frame members must be thoroughly washed with a mild detergent using a high pressure wand wash at 140°F (60°C). This process will remove mill oils, machine shop oils and weld antisplatter compounds from the surface to be treated.
2. All steel members to be thoroughly blown dry.
3. Using at least 50 grit, grit blast all surfaces to bare metal. Grit blast surfaces to an SSPC-SP6 profile of 1.0 to 2.5 mils. Wheel abrade any spots missed during grit blasting which still have rust, mill scale or weld spatter present. (SSPC-SP6/NACE No. 3 “Commercial Blast Cleaning” is a standard available from SSPC: The Society for Protective Coatings.)
This will provide the bonding surface required for adequate primer adhesion for corrosion protection.

Primer Application:

1. Apply primer to all exterior metal parts forming the structure.
2. Prepare a low VOC, two part Urethane, organic Zinc Rich Primer (such as PPG S2809 catalyst and S28080 zinc powder, or approved equal) by following the manufacturer’s instructions. Apply primer using appropriate spraying equipment. Wet film thickness should be 8.0 to 10.0 mils. This will result in a dry film of 5.0 to 6.0 mils. Film thickness is important to ensure adhesion and corrosion protection.
Ensure all surfaces are properly coated and allow a minimum of 4 hours curing time.

Frame Tubing Internal Coating:

Use an internal structural tube coating (such as PPG CoraTube, or approved equal).

1. Insert spray nozzle into tube through 1/2" hole previously drilled and spray sufficient compound to fully coat the internal vertical and horizontal faces of the tubing.
2. Remove spray nozzle and install sealing plugs in each hole.

Undercoating Application

Apply to all the under chassis areas exposed to road spray.

NOTE: Do not apply undercoat to the following components: axles, bellows, suspension beams, radius rods, steering box, leveling valves, brake valves, safety valves, drain cocks, and the air dryer.

1. Mix undercoating compound (such as PPG Corashield™ 7972, or approved equal) and thin to required consistency.
2. Ensure ambient temperature is between 50 and 90°F (10 and 32°C) and humidity is under 80%. Substrate temperature cannot exceed 212°F (100°C).
3. Spray repair areas with a wet film thickness of 11 to 14 mils while maintaining a spray distance of 12 to 15" (30 to 38 cm).
4. If undercoating will not adhere properly, wash area with appropriate solvent and allow drying for 5 to 10 minutes. Repeat spraying process and allow undercoating to set for a minimum of 10 minutes. Allow adequate air flow to ensure even drying. Material should be dry to touch in 30 minutes, dry hard in 24 hours and fully cured in 72 hours.

The proposer shall submit documentation on proposal due date that explains how they met all corrosion requirements listed above.

Corashield 7947 applied to the structural exterior and underbody, And Cora Tube applied to the inside structural tubing from the window-line down is Approved

TS 25. Towing

Each towing device shall withstand, without permanent deformation, tension loads up to 1.2 times the curb weight of the bus within 20 deg 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.

DEFAULT-----APPROVED

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.

*A shop air connector, Foster 10-3 and tethered dust cap have been **APPROVED**.*

DEFAULT-----APPROVED

No Provision of Glad-Hand Type Connectors for Towing

No glad-hand type connector shall be provided.

DEFAULT-----APPROVED

Lifted (Supported) Front Axle and Flat Towing Capability

The front towing devices shall allow attachment of adapters for a rigid tow bar and shall permit the lifting of the bus until the front wheels are clear off the ground in order to position the bus on the towing equipment by the front wheels. These devices shall also permit common flat towing.

Two rear recovery devices/tie downs shall permit lifting and towing of the bus for a short distance, such as in cases of an emergency, to allow access to provisions for front towing of bus. The method of attaching the tow bar or adapter shall require the specific **approval of the Agency**. Any tow bar or adapter exceeding 50 lbs should have means to maneuver or allow for ease of use and application. Each towing device shall accommodate a crane hook with a 1 in. throat.

TS 26. Jacking

It shall be possible to safely jack up the bus, at curb weight, with a common 10-ton 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. The bus shall withstand such jacking at any one or any combination of wheel locations

without permanent deformation or damage.

DEFAULT-----APPROVED

Yellow Pads

Jacking pads shall be painted safety yellow.

TS 27. Hoisting

The bus axles or jacking plates shall accommodate the lifting pads of a two-post (or three-post if 60 ft articulated bus) hoist system. Jacking plates, if used as hoisting pads, shall be designed to prevent the bus from falling off the hoist. Other pads or the bus structure shall support the bus on jack stands independent of the hoist.

The vehicle shall be capable of lifting by the wheels, and, as necessary to meet tire load requirements, the proper number for wheel lifts and/or adapters must be used.

TS 28. Floor

TS 28.1 Design (Transit Coach)

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, 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. The vehicle floor in the area of the entrance and exit doors shall have a lateral slope not exceeding 2 deg to allow for drainage.

DEFAULT-----APPROVED

Bi-Level Floor Design

The 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 deg off the horizontal.

~~TS 28.2 Design (Commuter Coach)~~

~~TS 28.3 Design (Articulated Transit Coach)~~

TS 28.4 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 in. radius, without permanent visible deformation.

TS 28.5 Construction

The floor 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.

DEFAULT

Pressure-Preserved Plywood Panel

Plywood shall be certified at the time of manufacturing by an industry-approved third-party inspection agency such as APA – The Engineered Wood Association (formerly the American Plywood Association). Plywood shall be of a thickness adequate to support design loads, manufactured with exterior glue, satisfy the requirements of a Group I Western panel as defined in PS 1-95 (Voluntary Product Standard PS 1-95, “Construction and Industrial Plywood”) and be of a grade that is manufactured with a solid face and back. Plywood shall be installed with the highest-grade, veneer side up. Plywood shall be pressure-treated with a preservative chemical and process such as alkaline copper quaternary (ACQ) that prevents decay and damage by insects. Preservative treatments shall utilize no EPA-listed hazardous chemicals. The concentration of preservative chemicals shall be equal to or greater than required for an above ground level application. Treated plywood will be certified for preservative penetration and retention by a third-party inspection agency. Pressure-preservative treated plywood shall have a moisture content at or below 15 percent.

The following floor Construction is APPROVED:

Greenwood Forest, NT’s ACQ Bus Panel ¾ in. -7-PLY Veneer plywood Floor that is undercoated with Corashield for superior protection against the elements.. Pressure treated plywood shall be supplied in the wheelchair ramp cavity also. The forward five (5) feet of the upper level floor has been designed with a light weight durable molded “Fiberglass honey comb core with polyester resin” composite which incorporates a stylized step up to the upper level on the 40 ft. bus. Green Forest, NT’s ACQ Bus panel does not require sealing of cut edges as it is developed to assure full penetration and retention of ACQ, the environmentally-friendly preservative that prevents decay and insect damage.

ALTERNATIVE-----APPROVED

Composite flooring.

TS 28.6 Construction (Commuter Coach)

TS 29. Platforms

TS 29.1 Driver’s Area

The covering of platform surfaces and risers, except where otherwise indicated, shall be the same material as specified for floor covering. Trim shall be provided along top edges of platforms unless integral nosing is provided.

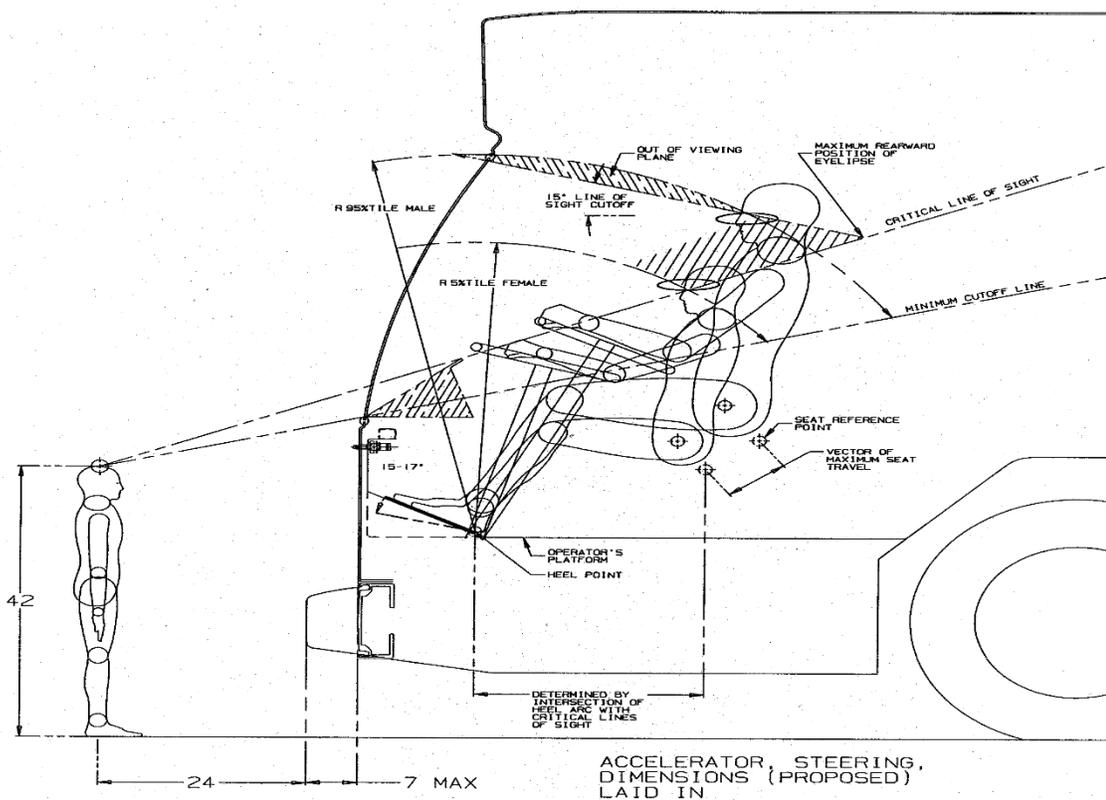
DEFAULT-----APPROVED

No specific trim.

TS 29.2 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 deg. A warning decal or sign shall be provided to alert the driver to the change in floor level. **Figure 2** illustrates a means by which the platform height can be determined, using the critical line of sight.

FIGURE 2
Determining Platform Height



TS 29.3 Farebox

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

DEFAULT-----APPROVED

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.

The farebox base is approximately 13 in. by 13 in. The farebox platform is not to be usable as a step for the bus operator. A No-Step farebox platform provides additional maneuverability space for mobility devices.



TS 29.4 Rear Step Area to Rear Area (Transit Coach)

If the vehicle is of a bi-level floor design, then a rear step area shall be provided along the center aisle of the bus to facilitate passenger traffic between the upper and lower floor levels. This step area shall be cut into the rear platform and shall be approximately the aisle width, a minimum 12 in. deep and approximately half the height of the upper level relative to the lower level. The horizontal surface of this platform shall be covered with skid-resistant material with a visually contrasting nosing and shall be sloped slightly for drainage. A warning decal or sign shall be provided at the immediate platform area to alert passengers to the change in floor level.

TS 30. Wheel Housing

TS 30.1 Design and Construction

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. Wheel housings shall be constructed of corrosion-resistant and fire-resistant material.

Wheel housings, as installed and trimmed, shall withstand impacts of a 2 in. steel ball with at least 200 ft-lbs of energy without penetration.

TS 30.2 Design and Construction (Transit Coach)

Interference 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 curb weight to GVWR. Wheel housings shall be adequately reinforced where seat pedestals are installed. Wheel housings shall have sufficient sound insulation to minimize tire and road noise and meet all noise requirements of this specification.

Design and construction of front wheel housings shall allow for the installation of a radio or electronic equipment storage compartment on the interior top surface, or its use as a luggage rack.

The finish of the front wheel housings shall be scratch-resistant and complement interior finishes of the bus to minimize the visual impact of the wheel housing. If fiberglass wheel housings are provided, ~~then they shall be color impregnated (dark matte gray) to match interior finishes.~~ The lower portion extending to approximately 10 to 12 in. above the floor and extended forward to the fare box pedestal shall be equipped with ~~seuff-resistant coating or~~ stainless steel trim.

A black wheelhouse cover is APPROVED

Wheel housings not equipped with seats or equipment enclosure shall have a horizontal assist mounted on the top portion of the housing no more than 4 in. higher than the wheel well housing. Horizontal assist on wheel housings measuring 6.7" from the housing service is Approved.

Provide front wheel housings with square tops.

Luggage rack tops that are rectangular and measure 30" x 19.5" are APPROVED.

DEFAULT-----APPROVED

No provision shall be made to chain regular transit buses.

ALTERNATIVE

The wheel housing shall be designed to have the ability to chain buses.

~~TS 30.3 Articulated Joint (Articulated Transit Coach)~~

~~TS 30.4 Raceway (Articulated Transit Coach)~~

TS 30.5 Bellows

CHASSIS

TS 31. Suspension

TS 31.1 General Requirements

The front, rear and mid (if articulated) suspensions shall be pneumatic type. The basic suspension system shall last the service life of the bus without major overhaul or replacement. Adjustment points shall be minimized and shall not be subject to a loss of adjustment in service. Routine adjustments shall be easily accomplished by limiting the removal or disconnecting the components.

TS 31.2 Alignment

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

TS 31.3 Springs and Shock Absorbers

TS 31.3.1 Suspension Travel

The suspension system shall permit a minimum wheel travel of 2.75 in. jounce-upward travel of a wheel when the bus hits a bump (higher than street surface), and 2.75 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.

TS 31.3.2 Damping

Vertical damping of the suspension system shall be accomplished by hydraulic shock absorbers 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 three cycles or less after hitting road perturbations. 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. Provide hydraulic shock absorbers that can be manually adjusted for stiffness.

“Koni” shock absorbers have been APPROVED

TS 31.3.3 Lubrication

DEFAULT-----APPROVED

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.

TS 31.3.4 Kneeling

DEFAULT-----APPROVED

A kneeling system shall lower the entrance(s) of the bus a minimum of 2 in. during loading or unloading operations regardless of load up to GVWR, measured at the longitudinal centerline of the entrance door(s) by the driver. ***A kneeling rate of 2" per second is Approved.*** 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 4 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 0.2 g, and the jerk shall not exceed 0.3 g/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.

The "raise" function (only) shall be operable while the bus is in motion, and shall be controlled by a momentary contact switch. This will enable the operator to raise the front above normal ride height when negotiating dips, gutters, etc. The bus shall automatically return to normal height quickly after the switch is released.

Provide a minimum of two (2) air ride springs on the front axle and a minimum of four (4) air ride springs on the rear axles for a firm suspension and anti-roll features. The outside edge of the rear air springs shall be located in front of and to the rear of the dual wheels, no more than six-inches from the bus sidewalls.

The outside edge of the rear air springs measuring 11" inboard from the outer skin of the bus sidewalls or more specifically, 7.9" inboard from the closest edge of the side structure is APPROVED.

All bolts/nuts used to mount suspension components shall be coated with anti-seize on the threads.

TS 32. Wheels and Tires

TS 32.1 Wheels

All wheels shall be interchangeable except for the middle axle of an artic **where a super single tire size is used** and shall be removable without a puller. Wheels shall be compatible with tires in size and load-carrying capacity. Front/Rear/Spare/(all) wheels and tires shall be dynamically balanced as an assembly per SAE J1986.

ALTERNATIVE-----APPROVED

Two-sided polished aluminum rims with cryogenic hardened surfaces and flanges to prevent premature wear.

Provide a total of eleven (11) wheels per bus. Mount 1 wheel for the spare tire. The other (4) spare wheels are for the Agency to mount snow tires on for winter use. (**Spare wheels to be included in the bus price**)

Provide 6 plastic wheel separators per bus for installation by the Agency between all wheels and hubs.

Provide double seal, Flow-Through Valve Stem Caps that do not stick so air will not slowly exhaust from the tire.

Provide Valve Stems that are the right length for use with long double seal flow-through stem caps.

Provide lug nut covers with a chrome appearance for all lug nuts on the bus.

Alcoa Dura Bright and Dura Flange wheels have been **APPROVED**.

Myers V2B Flow through Valve Stem Caps (21534) for all mounted wheels have been **APPROVED**.

Dill (VS-554-D) Valve Stems for all mounted wheels have been **APPROVED**.

Alcoa #000185 Lug Nut Covers have been **APPROVED**.

DEFAULT-----APPROVED

Standard non-locking lug nut.

TS 32.2 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.

~~Sufficient space shall be provided to allow the Agency to carry a spare tire, if required.~~

DEFAULT-----APPROVED

The tires shall be provided under a lease agreement between the Agency and the tire supplier and shall be the appropriate size and load range for the vehicle.

TS 33. Steering

DEFAULT-----APPROVED

Hydraulically assisted steering shall be provided. The steering gear shall be an integral type with the number and length of flexible lines minimized or eliminated. ~~Engine driven~~ hydraulic pump shall be provided for power steering. Provide a pressure fitting off of the steering gear to test hydraulic pressure.

ALTERNATIVE-----APPROVED

Electrically assisted steering shall be provided to reduce steering effort. – The Agency requests this be a part of the base bus price.

The TRW Electric Steering Assist has been **APPROVED**.

TS 33.1 Steering Axle (Transit Coach)

ALTERNATIVE-----APPROVED

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.

Front M.A.N axles with “Unitized”, non-serviceable, maintenance free wheel bearings - **APPROVED**.

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

TS 33.2 Steering and Tag Axles (Commuter Coach)

TS 33.3 Steering Wheel

TS 33.3.1 Turning Effort

Steering effort shall be measured with the bus at GVWR, stopped with the brakes released and the drive system in an operational state ~~engine at normal idling speed~~ on clean, dry, level, commercial asphalt pavement and the tires inflated to recommended pressure.

Under these conditions, the torque required to turn the steering wheel 10 deg shall be no less than 5 ft-lbs and no more than 10 ft-lbs. Steering torque may increase to 70 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 55 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.

TS 33.3.2 Steering Wheel, General

The steering wheel diameter shall be approximately ~~18 to 20~~ **16** in.; the rim diameter shall be 7/8 to 1 1/4 in. and shaped for firm grip with comfort for long periods of time.

Steering wheel spokes and wheel thickness shall ensure visibility of the dashboard so that vital instrumentation is clearly visible at center neutral position (within the range of a 95th-percentile male, as described in SAE 1050a, Sections 4.2.2 and 4.2.3). Placement of steering column must be as far forward as possible, but either in line with or behind the instrument cluster.

*The VIP 16 inch, Soft Touch, 2 Spoke Steering Wheel has been **APPROVED**.*

A 16" steering wheel standard with the Electric Assist Steering Column offered as standard in conjunction with base bus price to include electric assist steering.

TS 33.3.3 Steering Column Tilt

The steering column shall have full tilt capability with an adjustment range of no less than 40 deg from the vertical and easily adjustable by the driver and shall be accessible by a 5th percentile female and 95th percentile male.

TS 33.3.4 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 4
Steering Wheel Height¹ Relative to Angle of Slope

At Minimum Telescopic Height Adjustment (29 in.)		At Maximum Telescopic Height Adjustment (5 in.)	
Angle of Slope	Height	Angle of Slope	Height
0 deg	29 in.	0 deg	34 in.
15 deg	26.2 in.	15 deg	31.2 in.
25 deg	24.6 in.	25 deg	29.6 in.
35 deg	22.5 in.	35 deg	27.5 in.

– 1. Measured from bottom portion closest to driver.

TS 34. Drive Axle

The bus shall be driven by a heavy-duty axle 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 300,000 miles on the design operating profile without replacement or major repairs. 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.

The axle ratio of the drive axle is to be optimum for the electric propulsion drive system. Any change in ratio needed to meet the agency's local operating conditions shall be included in the base bus price.

TS 34.1 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.

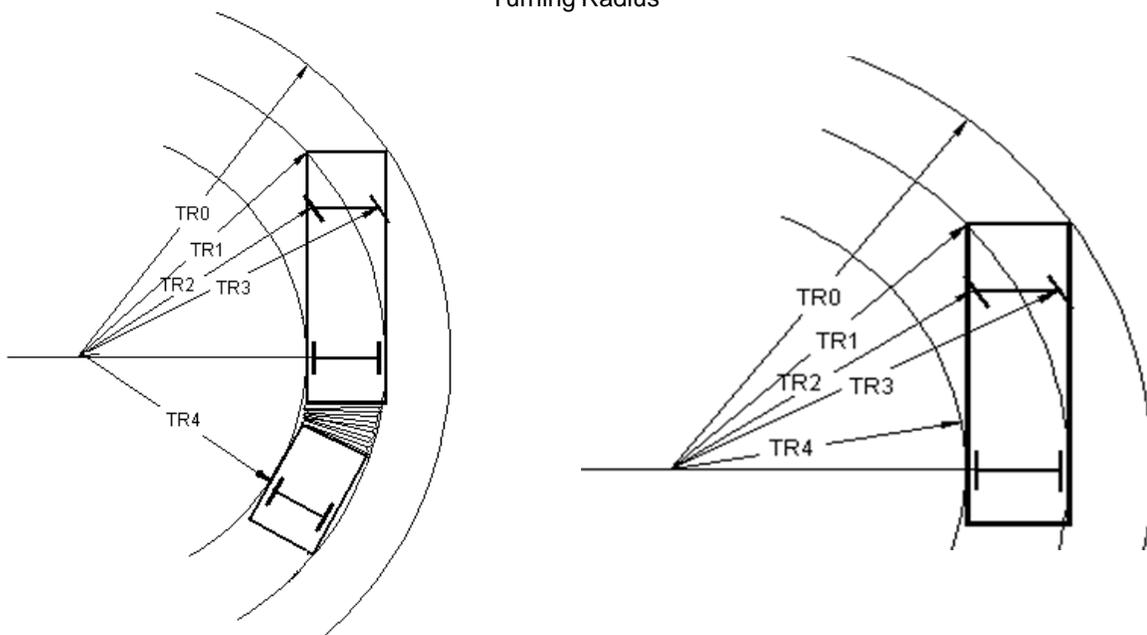
TS 35. Tag Axles (Commuter Coach)

TS 36. Turning Radius

TABLE 5
Maximum Turning Radius

Bus Length (approximate)	Maximum Turning Radius (see Figure 3)	Agency Requirement
30 ft	31 ft (TR0)	<u>31'</u>
35 ft	39 ft (TR0)	<u>39'</u>
40 ft	44 ft (TR0)	<u>44'</u>
45 ft	49 ft (TR0)	<u>49'</u>
60 ft	44.5 ft (outside front axle, TR0) 17 ft (inside rearmost axle, TR4)	<u>44.5'</u> <u>17'</u>

FIGURE 3
Turning Radius



TS 37. Brakes

TS 37.1 Service Brake

DEFAULT-----APPROVED

Brakes shall be self-adjusting. Brake wear indicators (visible brake sensors) shall be provided on exposed push rods.

ALTERNATIVE-----APPROVED

Visible stroke indicators may be combined with electronic brake monitoring system and vehicle brake warning system to notify driver and maintenance of unsafe brake conditions.

*Vehicles provided under this RFP are to include Electronic Brake Monitoring (specifically brake stroke) as part of the vehicle air disc braking on-board diagnostic system. The Electronic Brake Monitoring System (EBMS) shall include both parking brake and service brake electronic monitoring utilizing a computer module with appropriate software, brake application pressure sensing via pressure transducer(s), associated cabling communicating the required electronic signals, and optical as well as mechanical sensing at the brake actuator / air disc caliper. The EBMS system shall be designed to detect over-stroke, non-functioning, brake drag and low pad-to-rotor clearance conditions at each vehicle wheel end. **The Agency requests this be a part of the base bus price.***

Any wheel-end brake fault condition detected by the EBMS shall be communicated via SAE brake fault codes over the vehicle J-1939 network in real-time. These predefined fault codes shall provide instant warnings to operations and maintenance of critical brake system problems which may affect the safe operation of vehicle.

The system shall specifically employ embedded optical and mechanical sensing at each wheel end which

monitors operational conditions for air brake delivery and release, (as well as mechanical conditions inside the caliper that effect lining and pad clearance), and the proper mechanical functionality of air disc calipers at each wheel end position

The on-board EBMS shall be designed to augment safety and aid maintenance in determining when to perform necessary unscheduled maintenance to mitigate vehicle performance and safety concerns. The EBMS shall additionally provide a log of stored fault codes for later retrieval by maintenance personnel to additionally be utilized by maintenance personnel for vehicle troubleshooting. The system shall also provide additional capability for conducting electronic pre-trip and/or post trip inspection on air disc brake vehicles.

The E-stroke Brake Monitoring System has been APPROVED.

TS 37.2 Actuation

DEFAULT-----APPROVED

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 75 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. The total braking effort shall be distributed among 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 thermodynamic brake balance test upon request. The Agency requires a copy of the complete test.

ALTERNATIVE-----APPROVED

Microprocessor controlled automatic traction control (ATC) shall be provided on all buses. The Agency requests this be a part of the base bus price.

Provide a momentary type Mud and Snow switch on the dash. This switch is to be used temporarily by the bus operator when the ATC is activated to the point the electric drive system has derated to the point of removing almost all power to the drive wheels. The Mud and Snow switch temporarily over-rides the ATC and allows for maximum throttle if necessary, regardless of wheel slip.

TS 37.3 Friction Material

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 a 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.

ALTERNATIVE-----APPROVED

Remote brake wear indicator shall be provided. The Agency requests this be a part of the base bus price.

TS 37.4 Hubs and Drums/Discs

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 when operating on the design operating profile for the duration of the initial manufacturer's warranty.

ALTERNATIVE-----APPROVED

Disc Brakes on All Axles *Disc Brakes should be considered the Default with the base bus price.*

The bus shall be equipped with disc brakes on all axles, and the brake discs shall allow machining of each side of the disc to obtain smooth surfaces per manufacturer's 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 the brake linings.

~~TS 37.5 Hubs and Drums (Commuter Coach)~~

TS 37.6 Parking/Emergency Brake

DEFAULT-----APPROVED

Air Brakes

The parking brake shall be a spring-operated system, actuated by a valve that exhausts compressed air to apply the brakes. The parking brake may be manually enabled when the air pressure is at the operating level per FMVSS 121.

Emergency Brake

An emergency brake release shall be provided to release the brakes in the event of automatic emergency brake application. The driver shall be able to manually depress and hold down the emergency brake release valve to release the brakes and maneuver the bus to safety. Once the driver releases the emergency brake release valve, the brakes shall engage to hold the bus in place. Air to the emergency brake release system shall be provided by a dedicated emergency air tank.

TS 38. Interlocks (Transit Coach)

TS 38.1 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 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.

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 an unsecured condition, unless the door master switch has been actuated to intentionally release the interlocks.

DEFAULT-----APPROVED

Non-adjustable brake interlock regulator.

DEFAULT-----APPROVED

No requirements for accelerator and brake interlocks whenever front doors are open.

TS 39. Pneumatic System

TS 39.1 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.

Provision shall be made to apply shop air to the bus air systems. A quick disconnect fitting shall be easily accessible and located in the electric drive compartment and near the front bumper area for towing *and for filling the air tanks of the bus*. Retained caps shall be installed to protect fitting against dirt and moisture when not in use. Air for the compressor shall be filtered. The air system shall be protected per FMVSS 121.

If retaining caps on tow fittings cannot be not provided. – The Agency will work with the vendor to determine the best solution after award in pre-production stage.

A Foster #10-3 with a tethered dust cap has been APPROVED.

TS 39.2 Air Compressor

DEFAULT-----APPROVED

~~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 4 minutes while not exceeding the fast idle speed setting of the engine.~~

TS 39.3 Air Lines and Fittings

Air lines, except necessary flexible lines, shall conform to the installation and material requirements of SAE Standard J1149 for copper tubing with standard, brass, flared or ball sleeve fittings, or SAE Standard J844 for nylon tubing if not subject to temperatures over 200 °F. 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:

DEFAULT-----APPROVED

- **Green:** Indicates primary brakes and supply.
- **Red:** Indicates secondary brakes.
- **Brown:** Indicates parking brake.
- **Yellow:** Indicates compressor governor signal.
- **Black:** Indicates accessories.
- **An additional air line- Blue for suspension - APPROVED**

Line supports shall prevent movement, flexing, tension, strain and vibration. Copper lines shall be supported 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 30 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 a #16 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, swivel-type fittings. 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~~ 30 in. intervals or less.

Air lines shall be clean before installation and shall be installed to minimize air leaks. All air lines shall be routed to prevent water traps to the extent possible. Grommets or insulated clamps shall protect the air lines at all points where they pass through understructure components. All flexible air lines (except air compressor discharge air line to the air dryer) are to be covered with split plastic conduit. ***Flexible hoses that are adequately clamped to ensure that there is no chaffing and when hoses are routed close to the heat source adequate protection is provided is Approved without split plastic conduit.***

TS 39.4 Air Reservoirs

All air reservoirs shall meet the requirements of FMVSS Standard 121 and SAE Standard J10 and shall be equipped with drain plugs and 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. If 1/4 turn valves are used anywhere on the bus, provide valves with a minimum pressure rating of 150 psi.

TS 39.5 Air System Dryer

An air dryer shall prevent accumulation of moisture and oil in the air system. The air dryer system shall include ~~one or more~~ two replaceable spin-off desiccant cartridges, two electrically heated drains, two oil separator filters and is capable of handling up to a 100% air compressor duty cycle with a maximum of 30.7 cfm.

A SKF Dual Turbo-2000 Air Dryer with double oil and water filtration, heated, has been APPROVED.

The Bendix AD-IP Tandem has been Approved.

DEFAULT-----APPROVED

No requirements for additional oil separator provision.

ALTERNATIVE-----APPROVED

The air system shall be equipped with an air dryer located before the no. 1 air tank and as far from the compressor as possible to allow air to cool prior to entering the air dryer.

ELECTRICAL, ELECTRONIC AND DATA COMMUNICATION SYSTEMS

TS 40. 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 on board 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:

- **Powertrain level:** Components related to the powertrain, including the propulsion system components (~~engine, transmission and hybrid units~~) and anti-lock braking system (ABS), which may include traction control. At a minimum, powertrain components ~~consisting of the engine, transmission, retarder, ASR and anti-lock braking systems~~ shall be powered by a dedicated and isolated ignition supply voltage to ensure data communication between components exists when the vehicle ignition is switched to the “on” position.
- **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, fareboxes, 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 (if applicable); and gateway devices.

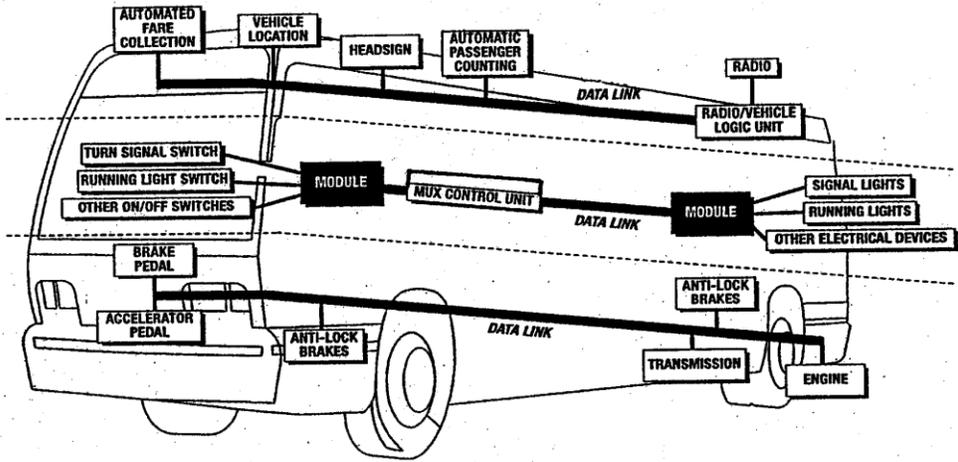
FIGURE 4

Data Communications Systems Levels

Information level

Multiplex level

Drivetrain level



TS 40.1 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.

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

TS 41. 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 (R10).

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.

TS 41.1 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.

TS 42. General Electrical Requirements

TS 42.1 Batteries

TS 42.1.1 Low-Voltage Batteries (24 V)

~~DEFAULT~~-----APPROVED

Same Size Terminal Ends

Positive and negative terminal ends shall be the same size.

NOTE: Agency to specify post size if different sized terminal ends are utilized.

ALTERNATIVE-----APPROVED *(If applicable for Electric Propulsion,)*

Four Group 31 AGM Batteries

Four Group 31 Series deep-cycling sealed non spillable maintenance free absorbed glass mat (AGM) batteries shall be provided. Each battery shall have a minimum of 1000 cold cranking amps (CCA) at 0 °F. The batteries shall be *designed and installed to withstand the operating environment. Each battery shall have a purchase date no more than one year from the date of release for shipment to the Agency.*

Additional specifications for AGM Batteries

- Requires a built in handle
- Reserve Capacity: 200 minutes minimum at a 25 amp discharge at 0° F.
- Must meet or exceed SAE J2185, minimum cycle rating for “Commercial Starting is 200 cycles” and “Deep cycle is 300 cycles”. Bidders must provide proof that batteries meet or exceed this requirement with their offer.
- Positive and negative plate construction: Pure lead or pure lead/tin.
- Battery terminals: Top mounted 3/8 inch coarse thread, stainless steel terminals with lead or brass pads, aligned on the longitudinal centerline of the battery.
- Warranty: 4 year full replacement warranty.
- Must be available for delivery locally.

An Odyssey AGM Battery 31-PC2150S-H has been APPROVED.

TS 42.1.2 Battery Cables

The battery terminal ends and cable ends 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, shall be flexible and shall be 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. 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 SGR, SGT, SGX or GXL and SAE Recommended Practice J541, with 2100 strand 4/0 cable or greater recommended.

ALTERNATIVE-----APPROVED

Color code each voltage.

A jumper power cable in the fuse box which links the disconnect switch to the main 24V busbar. A power cable feeds the starter from the main 24V busbar is APPROVED.

TS 42.1.3 Jump Start *(If applicable for Electric Propulsion)*

Base bus price to include front and rear jump connectors .

ALTERNATIVE-----APPROVED

Jump-Start Connector

A jump-start connector, red for 24 V and blue for 12 V, shall be provided in the electric drive compartment, equipped with dust cap and adequately protected from moisture, dirt and debris. Provide access to the connector by opening the large rear electric drive access door

The Whitaker #15121 jump-start connector with dust cap has been APPROVED.

ALTERNATIVE-----A second 24 V Jump-Start connector is APPROVED

Jump-Start Connector

A jump-start connector shall be located next to the battery disconnect switch if the disconnect switch is located at the front of the bus.

The Whitaker #15121 jump-start connector with dust cap has been APPROVED.

The Whitaker jumpstart 15126 is APPROVED provided the connection matches the 15121 to allow for backwards compatibility.

TS 42.1.4 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. 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 temperature should not exceed manufacturers specification.

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

A disconnect switch located on the fuse box with access through a flip open door positioned on the curbside electric drive compartment door when the fuse box is located directly rearward of the battery tray is APPROVED

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

The battery hold-down bracket shall be constructed of a nonconductive and corrosion-resistant 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, if applicable, 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. One or more ~~A~~ locking device(s) shall retain the battery tray to the stowed position to prevent the battery tray from rattling and bouncing around.

A polyethylene battery tray supported by a stainless steel sub-frame, with an enclosure that is also polyethylene, and batteries supported by structural stainless steel U-channels, sized to provide the correct support for 4 GP 31 batteries is APPROVED.

The location of the batteries or the design of the battery box, must keep the majority of the road spray off the batteries. The batteries shall not be located in the hot electric drive compartment unless the batteries have their own enclosure that protects them from the high electric drive compartment heat. This box must slide or rotate out easily and be corrosion proof. A battery box with ¼ inch or larger stainless steel ball rollers is acceptable.

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

TS 42.1.5 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.

TS 42.1.6 Master Battery Switch

The location of the *heavy duty* master battery *knife* switch shall be clearly identified on the exterior access panel, be accessible with-out locks 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.

A rotary style disconnect switch supplied by Kissling is APPROVED.

Turning the master switch off with the ~~powerplant operating~~ bus in an operational state, during an emergency, 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.

DEFAULT-----APPROVED

Single Switch

The batteries shall be equipped with a single switch for disconnecting both 12 V and 24 V power.

TS 42.1.7 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 32 V) 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.

TS 42.1.8 Circuit Protection

All branch circuits, except ~~battery to starting motor and battery to generator/alternator circuits~~ *except where applicable for Electric Propulsion*, 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.

TS 42.2 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. No more than five ground ring/spade terminal connections shall be made per ground stud with spacing between studs ensuring contactivity and serviceability. Electronic equipment requiring an isolated ground to the battery (i.e., electronic ground) shall not be grounded through the chassis *but to the battery ground cable*.

TS 42.3 Low Voltage/Low Current Wiring and Terminals

All power and ground wiring shall 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, numbered and/or 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 one wire) excess wires for spares. This requirement for spare wires does not apply to datalinks and communication cables. Wiring harness length shall allow end terminals to be replaced twice without pulling, stretching or replacing the wire. Terminals shall be crimped to the wiring according to the connector manufacturer's recommendations for techniques and tools. All cable connectors shall be locking type, keyed and sealed, unless enclosed in watertight cabinets or vehicle interior. Pins shall be removable, crimp contact type, of the correct size and rating for the wire being terminated. Unused pin positions shall be sealed with sealing plugs. Adjacent connectors shall use either different inserts or different insert orientations to prevent incorrect connections.

Terminals shall be crimped, corrosion-resistant and full ring type or interlocking lugs with insulating ferrules. 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 8 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.
- *If harnesses with T-splices are located so they will be in contact with liquid corrosive magnesium and sodium chloride salts, the T-splices will need to be examined by the Agency for being weather-proof on a case by case basis.*

T-splices made from pre-molded weather sealed T-connectors may be approved by the Agency.

A "T" or a "Y" connection using Packard Electric, WeatherPack connectors has been APPROVED.

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 electric drive 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.

TS 42.4 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.

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, auxiliary heater pumps, defroster and wiper motors). All electric motors shall be easily accessible for servicing.

TS 42.5 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. 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.

A side console decal is shipped loose is APPROVED

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 electric drive compartment and shall be protected from the environment.

TS 42.6 Electrical Corrosion Prevention Requirements

- The Agency is extremely concerned about corrosion. During the winter months, the Agency's buses are covered with sodium chloride, calcium chloride, liquid magnesium chloride, and sand soaked in salt and moisture. Even though the exteriors are washed frequently, these elements cover the bus and work their way into the bus body and wiring connections. Many of the electrical specifications as written in this section have been developed over the 34 years this writer has purchased buses and for the total of 39 years being in bus maintenance. These performance specifications help combat the destructive corrosion caused by the chlorides and moisture.*
- Only non-insulated, tin/lead covered, brazed seam, copper electrical terminals will be used on the wiring underneath the bus, in the battery compartment, electric drive compartment, and HVAC compartment. All terminals and adjoining wires shall be covered with heat shrink tubing that has an inner meltable sealer. The heat shrink will act as insulation, a strain relief and will seal against the wire insulation. The heat shrink needs to be heated enough to have the melted sealer seep out from underneath the heat shrink tubing. Attach heat shrink before spraying the wires and terminals with corrosion preventer.*
- All positive and negative connections from 8 gauge and larger, that are located on the exterior of the bus, including but not limited to, underneath the bus, in the HVAC compartment, battery compartment, and in the electric drive compartment, shall be made against clean terminals and clean grounds. Before making the electrical connection, grind off any paint and undercoating to expose bare metal. BEFORE making a connection, spray the corrosion preventer on and around the clean metal, bolt, nut, washers and terminal. Use under the bolt heads and lock nuts, hardened flat washers (grade "C"). Split lock washers, star lock washers, or stainless steel washers, WILL NOT be allowed between the terminals and/or grounds. The Agency will decide if there are exceptions to this rule.*
- AFTER the connection is made, the Contractor shall spray the corrosion preventer on the connection again.*
- The battery cable terminals are to have heat shrink with a meltable sealer. Do not use the preformed, rubber covered terminal/cable assemblies that trap and hide corrosion.*
- Electrical terminals that end inside the bus or inside exterior weather proof junction boxes where moisture does not penetrate, ARE NOT to be sprayed with corrosion preventer. The corrosion preventer is very messy. These terminals may be of the standard insulated type.*
- All 10 gauge and smaller wires that are on the exterior of the bus and are connected as a "T" or "Y" or in-line with another wire, shall be connected together by weather proof connectors.*

8. Wires terminating in junction boxes (located anywhere on the bus), in the dash, shall terminate preferably at a stud/nut or screw. Tight spade type connectors may be used on a limited number of components, when there is no other choice, such as horns, that require a spade terminal. Any spade terminals on components which are located in areas where moisture can be present, must be sprayed from both sides of the insulated terminal with corrosion preventer. Be sure to cover the bare exposed copper wire with the corrosion preventer.
9. Cover the battery cable with split loom or provide battery cable conduit from the battery box to the starter motor.
10. **Corrosion Preventer Specifications:**
This material shall be: 1) a liquid that can be sprayed on terminals, bare copper wires, etc.; 2) the sprayed liquid shall have the ability to wick its way up stranded copper wires wrapped in an insulated vinyl jacket to provide a corrosion inhibited liquid barrier against air and corrosive liquids. This barrier prevents copper wires that are covered with vinyl insulation from corroding; 3) the liquid shall not dry out or become hard over time which could eventually act as an insulator if the terminal is removed and reattached; 4) the preventive corrosion spray shall be a bright red color for quick identification that the corrosion preventer has been applied; 5) the preventive corrosion spray shall be such a powerful deterrent that when tested, corrosive sodium chloride salts will not create a salt bridge over the corrosion inhibitor and will not wick its way up conductors covered with insulation when tested in a 206 °F heated salt/water vapor bath.
11. Send proposed corrosion preventer sprays with product information and any test results when requesting an Approved Equal. The proposed sprays will be tested by the Agency to see if they meet the preceding performance specifications.

The best available corrosion preventive spray that has been **APPROVED** is Battery Corrosion Preventive Spray, NOCO, NCP-2. This red spray is available in many auto part and battery stores as Part #A-202. This product is made by the NOCO Company in Cleveland, Ohio.

Not providing loom on the battery cables if located within a contained assembly is APPROVED.

TS 42.7 Other General Electrical Requirements (equalizer, min. alternator amps, clean air, nylon ties square cut smooth)

1. Provide heavy-duty bus-bars, terminal strips, or stud-terminal blocks. This means they do not crack, break, become loose, fall apart, and do not need constant preventive maintenance to check or tighten the studs or nuts. All electrical panels are to be located in clean, dry, weatherproof compartments, especially those electrical panels located in the electric drive compartment.
2. Provide a minimum 80-amp (12-volt) capable, 12/24 volt battery Equalizer.
3. If the alternator is belt driven, the belt must be entirely enclosed within a shroud that is hinged to the bus and locked with several 5/16" inch square lock(s).
4. Provide a minimum, 450 amp alternator.
5. If the alternator is air cooled, the air shall be clean as compared to the dirty electric drive compartment air or air from around the rear of the drive tires. The clean air for the alternator can come from one of two sources:
 - a. The air can be drawn from a cleaner air source near where an air intake would be for a traditional bus. Preferred method.
 - b. The air can be pre-cleaned by using a centrifuge type cleaner in the electric drive compartment.
6. Provide a separate 12-volt "cigarette" style power connector that can be used to power diagnostic laptops etc., somewhere near the interior main J1939 connector.
7. For ease of starting, especially in cold weather, when starting the engine from the front or the rear of bus, all un-necessary loads shall be eliminated by the use of the bus multiplex system.
8. Whenever nylon ties are used anywhere on the bus, they shall be square cut-off with a blunt cut-off

plier or tool. The nylon ties shall not have sharp or pointed edges.

TS 43. 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 32 V DC on a 24 V DC nominal voltage rating with a maximum of 50 V 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.

TS 43.1 Wiring and Terminals

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

TS 43.1.1 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.

TS 43.1.2 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 cs 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.

TS 43.1.3 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 powerline carriers (e.g., data modulated on a 24 V powerline) shall meet the most stringent applicable wiring and terminal specifications.

TS 43.1.4 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.

TS 43.1.5 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.

TS 44. Multiplexing

TS 44.1 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.

DEFAULT-----<u>APPROVED</u>

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

TS 44.2 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.

TS 44.2.1 I/O Signals

The input/output for the multiplex system may contain four types of electrical signals: discrete, modulating, 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 (0–12 V, 10–24 V, 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.

TS 45. Data Communications

TS 45.1 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 level 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.

TS 45.2 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. At a minimum, drivetrain components consisting of the ~~engine~~, transmission, ~~retarder~~ ASR, and anti-lock braking systems shall be powered by a dedicated and isolated ignition supply voltage to ensure data communication among components exists when the vehicle ignition is switched to the “on” position. Provide a gateway (J1939) and a 12 volt power plug (cigarette lighter type) inside the bus and close together for diagnostic laptop connections. Location TBD.

TS 45.2.1 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.

TS 45.2.2 Programmability (Software)

The drivetrain level components shall be programmable by the Agency with limitations as specified by the subsystem Supplier.

TS 45.3 Multiplex Level

TS 45.3.1 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.

Providing diagnostic connectors in four areas on the bus which are; the electric drive compartment switch box, under the left hand side of the dash, behind the driver on the SDS enclosure and in the SDS box. The diagnostic connectors available at each location:

Electric drive compartment Switch Box:

-9 pin diagnostic connector for Powertrain J1939

Under the Left Hand Side of the Dash:

-USB port for the Vansco Multiplexing System

Behind the driver on the SDS Enclosure:

-9 pin diagnostic connector for powertrain J1939 and chassis J1939

Inside the SDS enclosure:

-9 pin diagnostic connector for the agency installed Smart Drive camera system

TS 45.3.2 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.

DEFAULT-----APPROVED

No requirement for mock-up board.

TS 45.3.3 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 display the most recent revision number
- A method of determining which version of the software is currently in use in the multiplex system

DEFAULT-----APPROVED

Revision control labels shall be electronic.

TS 45.4 Electronic Noise Control

Electrical and electronic subsystems 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 subsystems 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

TS 46. Driver’s Area Controls

TS 46.1 General

In general when designing the driver’s area, it is recommended that SAE J833, “Human Physical Dimensions,” be used.

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.”

TS 46.2 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. Both front wheel housings are to be dark matte gray to reduce glare on the windshield. The use of polished metal and light-colored surfaces within and adjacent to the driver’s area shall be avoided.

Providing Black wheelhousings to reduce the glare on the windshield is APPROVED.

Providing a Vansco DPS70 dash display is Approved.

TS 46.3 Visors/Sun Shades

DEFAULT-----APPROVED

Front and Side Sun Shade/Visor

Adjustable sun visor(s) shall be provided for the driver's windshield and the driver's side window. Visors shall be shaped to minimize light leakage between the visor and windshield pillars. *To minimize light leakage, apply a dark shaded band similar in size and color to the windshield shaded band, to the glass between the visor and windshield/window pillars.* Visors shall store out of the way and shall not obstruct airflow from the climate control system or interfere with other equipment, such as the radio handset or the destination control. Deployment of the visors shall not restrict vision of the rearview mirrors. Visor adjustments shall be made easily by hand with positive locking and releasing devices and shall not be subject to damage by over-tightening. Sun visor construction and materials shall be strong enough to resist breakage during adjustments.

Visors may be transparent but shall not allow a visible light transmittance in excess of 10 percent. Visors, when deployed, shall be effective in the driver's field of view at angles more than 5 deg above the horizontal.

Provide manual pull-down/push-up style (solid) visors at driver's side window and street-side windshield.

Provide a curb-side windshield visor if it does not block the curb-side exterior mirrors. This visor shall pull down approximately 10 inches (TBD) and shall be mounted as close as possible to the windshield.

Automotion Sun Shades have been APPROVED.

The agency approves the disuse of a sunshade that blocks the mirror, but will work with vendor for a possible solution for a sunshade for the operator on the curbside.

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.

TS 46.4 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.

DEFAULT-----APPROVED

All switches/controls in the driver's controls area shall be mounted in an angled panel steep enough to discourage drivers from using it as a personal storage area for items like food, drinks, cell phones, etc.

ALTERNATIVE-----APPROVED

The transmission shift selector shall be mounted in an angled panel steep enough to discourage drivers from using it as a personal storage area for electronic devices such as cell phones, music players, navigation systems, etc.

TS 46.5 Normal Bus Operation Instrumentation and Controls

The following list identifies 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 *by using a dimmer switch*. All indicators *and dash lighting* shall be illuminated using *fiber optics for backlighting*.

The side console and any other controls the operator may use from his/her seat must be illuminated at night. The agency prefers fiber optic backlighting if available but will accept LED light.

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. **Table 6** represents instruments and alarms. 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.

A dash mounted MFD multifunction display shall be provided with a minimum screen size of 7" measured diagonally. The display shall have a brightness adjustment and incorporate all electronic gauges, all warning light indicators and rear view or any installed door camera images. The electronic gauges shall include but not be limited to: Large Font Speedometer, 24 volt gauge, Coolant Temp (1 for each coolant loop), 12 volt gauge.

A shift selector position will TBD in pre-production.

TABLE 6 (Transit Coach)
Transit Bus Instruments and Alarms

Final instrument panel layout to be approved by the Agency pre-production. Location TBD.

Device	Description	Location	Function	Visual/ Audible
Master run switch	Rotary, four-position detent	Side console	Master control for bus, off, day run, night run and clearance ID lights	
Engine start, front	Approved momentary switch	Side console	Activates engine starter motor	
Engine start, rear	Approved momentary switch	Electric drive compartment	Activates engine starter motor	
Engine run, rear	Three-position toggle switch	Electric drive compartment	Permits running engine <i>activating propulsion system</i> from rear start, normal front run position and off	Amber light
Drive selector	Touch panel switch	Side console <u>TBD</u>	Provides selection of propulsion: forward, reverse and neutral	Gear selection
HVAC	Switch or switches to control HVAC	Side console	Permits selection of passenger ventilation: off, cool, heat, low fan, high fan or full auto with on/off only	
Driver's ventilation	Rotary, three-position detent	Side console or dash left wing	Permits supplemental ventilation: fan off, low or high	
Defroster fan	Rotary, three-position detent	Side console or dash left wing	Permits defroster: fan off, low, medium or high	
Defroster temperature	Variable position	Side console or dash left wing	Adjusts defroster water flow and temperature	
Windshield wiper	One-variable rotary position operating both wipers	Dash left wing	Variable speed control of left and right windshield wipers	
Windshield washer	Push button	Dash left wing	Activates windshield washers	
Dash panel lights	Rotary rheostat or stepping switch	Side console or dash left wing	Provides adjustment for light intensity in night run position	

Interior <u>Dome</u> light <u>switch</u>	Three-position switch	Side console or front dash	<u>Reduces interior light reflection from the windshield at night.</u> Selects mode of passenger compartment lighting: off, on, normal <u>All, Off, Normal</u>	<u>“All” = all Dome lights “on” when doors are open or closed.</u> <u>“Off” = all Dome lights “off”.</u> <u>”Normal” = only street-side Dome lights “on” when all doors are closed.</u> <u>When either door is opened, all Dome lights are “on”.</u>
<u>Dimmer Switch for all Dome lights or knob</u>	<u>Two position switch or knob</u>	<u>Next to the “Interior Dome Light” three-position switch.</u>	<u>Select mode: “Bright”, “Dim”</u>	<u>“Bright” = All Dome lights are 100% “bright”.</u> <u>“Dim” = All Dome lights dimmed to 60% bright when both front and rear doors are closed. When one or both doors are open, dome lights are 100% bright.</u>
Fast idle	Two-position switch	Side console	Selects high idle speed of engine	
WC ramp/ kneel enable	Two-position switch [†]	Side console or dash right wing	Permits operation of ramp and kneel operations at each door remote panel	Amber light
Front door ramp/kneel enable	Two-position keyed switch [†]	Front door remote or dash right wing	Permits ramp and kneel activation from front door area; key required [†]	Amber light
Front door ramp	Three-position momentary switch <u>Buttons on door control handle</u>	Right side of steering wheel <u>door control handle</u>	Permits deploy and stow of front ramp	Red light/ <u>other</u>
Front kneel	Three-position momentary switch <u>Buttons on door control handle</u>	Front door remote <u>door control handle</u>	Permits kneeling activation and raise and normal at front door remote location	Amber or red dash indicator; exterior alarm (<u>only when raising or lowering</u>) and amber <u>flashing</u> light
Rear door ramp/kneel enable	Two-position keyed switch [†]	Rear door remote	Permits ramp and kneel activation from rear door area; key required [†]	Red light
Rear door ramp	Three-position momentary switch	Rear door remote	Permits deploy and stow of rear ramp	

Rear kneel	Three position momentary switch	Rear door remote	Permits kneeling activation and raise and normal at rear door remote location	
Silent alarm	Recessed push button, NO and NC contacts momentary <u>Heel switch</u>	Side console <u>On floor in front of Operator's seat</u>	Activates emergency radio alarm at dispatch and permits covert microphone and/or enables destination sign emergency message	<u>Harness and switch provided by the Agency and installed by the Contractor</u>
Video system event switch	on/off momentary switch with plastic guard	Side console	Triggers event equipment, triggers event light on dash	Amber light
Left remote <u>Flat & Convex</u> mirrors	<u>Single control</u> -Four position toggle type	Side console	<u>Individually</u> Permits two-axis adjustment of <u>both flat and convex</u> left exterior mirrors	
Right remote <u>Flat & Convex</u> mirrors	<u>Single control</u> -Four position toggle type	Side console	<u>Individually</u> Permits two-axis adjustment of <u>both flat and convex</u> right exterior mirrors	
Mirror heater	<u>Momentary 15 minute</u> Switch/button or temperature	Side console	Permits heating of <u>ALL</u> outside mirrors when required	<u>Lighted button with "Push on" decal near heated mirror decal</u>
Passenger door control	<u>A Vapor control handle with built in kneel and ramp controls with fiberoptic backlighting(or similar)</u> -Five position handle type detent or two momentary push buttons	Side console, forward	Permits open/close control of front and rear passenger doors	Red light
Rear door override	Two position switch in approved location	Side console, forward	Allows driver to override activation of rear door passenger tape switches	
Engine Propulsion system shutdown override	Momentary switch with operation protection	Side console	Permits driver to override auto engine-Propulsion system shutdown	

Hazard flashers	Two-position, <u>long handle steel</u> switch	Side console or dash right wing	Activates emergency flashers. <u>Not audible with parking brake activated. Medium audible clicking when "in gear" and parking brake released.</u>	Two green lights
Fire suppression	Red push button with protective cover	Dash left wing or dash center	Permits driver to override and manually discharge fire suppression system	Red light
	<u>Fire suppression manual actuator and fire suppression control module</u>	<u>Above the driver on the saw tooth panel</u>		
Mobile data terminal	Mobile data terminal coach operator interface panel	<u>Above the right of the right dash wing</u>	Facilitates driver interaction with communication system and master log-on	LCD display with visual status and text messages
Farebox interface	Farebox coach operator interface panel	Near farebox	Facilitates driver interaction with farebox system	LCD display
Destination sign interface	Destination sign interface panel	In approved location	Facilitates driver interaction with destination sign system, manual entry	LCD display
Turn signals	Momentary push button (two required) raised from other switches	Left foot <u>on 30% raised</u> panel	Activates left and right turn signals	Two green lights and optional <u>low</u> audible <u>clicking</u> indicator
PA manual	<u>Vendor provided.</u> Momentary push button	In approved location <u>on floor next to steering column</u>	Permits driver to manually activate public address microphone	
Low-profile microphone	Low-profile discrete mounting <u>Microphone provided as part of the PA amplifier</u>	Steering column <u>In approved location</u>	Permits driver to make announcements with both hands on the wheel and focusing on road conditions	
High beam	Detented push button <u>located above and between the two turn signal switches</u>	In approved location <u>Left foot on 30% raised panel</u>	Permits driver to toggle between low and high beam	Blue light

Parking brake	Pneumatic PPV (<i>must have metal knob</i>)	Side console or dash left wing	Permits driver to apply and release parking brake	Red light
Park brake release <i><u>Park brake release valve</u></i>	Pneumatic PPV	Vertical side of the side console or dash center. <i><u>Horizontal surface of the side console</u></i>	Permits driver to push and hold to release brakes	
Hill holder	Two-position momentary switch	Side console	Applies brakes to prevent bus from rolling <i><u>All hill holding/anti roll back devices shall be automatic and seamless to the operator.</u></i>	
Remote engine speed	Rotary rheostat <i><u>3-position momentary toggle switch (Increase-off-Decrease)</u></i>	Electric drive compartment	Permits technician to raise and lower engine RPM from electric drive compartment <i><u>in 250 rpm increments</u></i>	
Master door/interlock	Multi-pole toggle, detented	Out of operator's reach <i><u>in approved location</u></i>	Permits driver override to disable door and brake/throttle interlock	Red light
Warning interlocks deactivated	Red indicator light	Dash panel center	Illuminates to warn driver that interlocks have been deactivated	Red light
Retarder <i><u>Regen braking</u></i> disable	Multi-pole switch detented <i><u>2 position with red guard</u></i>	Within reach of operator or approved location	Permits driver override to disable brake retardation/regeneration (<i><u>only if allowable for electric propulsion system</u></i>)	Red light
Alarm acknowledge	Push button momentary	Approved location	Permits driver to acknowledge alarm condition	
Rear door passenger sensor disable	Multi-pole toggle, detented	In sign compartment or driver's barrier compartment	Permits driver to override rear door passenger sensing system	
Indicator/ alarm test button	Momentary switch or programming ¹	Dash center panel	Permits driver to activate test of sentry, indicators and audible alarms	All visuals and audibles

Auxiliary power	110 V power receptacle	Approved location	Property to specify what function to supply	
Speedometer	Speedometer, odometer, and diagnostic capability, 5- mile increments	Dash center panel/MFD	Visual indication of speed and distance traveled, accumulated vehicle mileage, fault condition display	Visual
Air pressure gauge	Primary and secondary, 5 psi increments	Dash center panel	Visual indication of primary and secondary air systems	Red light and buzzer
Fire detection	Coach operator display	Property specific or dash center	Indication of fire detection activation by zone/location	Buzzer and red light
Door obstruction	Sensing of door	Dash center	Indication of rear door sensitive edge activation	Red light and buzzer
Door ajar	Door not properly closed	Property specific or dash center	Indication of rear door not properly closed	Buzzer or alarm and red light
Low system air pressure	Sensing low primary and secondary air tank pressure	Dash center	Indication of low air system pressure	Buzzer and red light
Methane detection function	Detection of system integrity	Property specific or dash center	Detects system failure	No start condition, amber light
Methane detection	Indication of 20% LED emergency light (LEL)	Property specific or dash center	Detects levels of methane	Flashing red at 20% LEL
Methane detection	Indication of 50% LEL	Property specific or dash center	Detects levels of methane	Solid red at 50% LEL
Engine coolant indicator	Low coolant indicator may be supplied as audible alert and visual and/or text	Within driver's sight	Detects low coolant condition	Amber light
Hot engine <u>Drivetrain</u> indicator	Coolant temperature indicator may be supplied as audible alert and visual and/or text message	Within driver's sight	Detects hot engine <u>drivetrain</u> condition and initiates time delay shutdown	Red light
Low engine oil pressure indicator	Engine oil pressure indicator may be supplied as audible alert and visual and/or text message	Within driver's sight	Detects low engine oil pressure condition and initiates time-delayed shutdown	Red light
ABS indicator	Detects system status	Dash center	Displays system failure	Amber light
HVAC indicator	Detects system status	Dash center	Displays system failure	Amber or red light
Charging system indicator (12/24 V)	Detect charging system status	Dash center	Detects no charge condition and optionally detects battery high, low, imbalance, no charge condition, and initiates time-delayed shutdown	Red light flashing or solid based on condition

Bike rack deployed indicator	Detects bike rack position	Dash center	Indication of bike rack not being in fully stowed position	Amber or red light
Fuel tank SOC level	Analog gauge, graduated based on fuel type	Dash center	Indication of <u>SOC</u> fuel tank level/pressure	
DEF gauge	Level Indicator	Center dash	Displays level of DEF tank and indicates with warning light when low	Red light <u>Amber light</u>
Active regeneration	Detects status	Dash center	Indication of electric regeneration	Amber or red light
Turntable	Detects status	Dash center	Warning indication for hinge locking	Audible and amber warning and red light if locked
Turntable	Interlock momentary switch	Side console	Momentarily release interlock brakes due to overangled condition	
<u>Mud and Snow Switch</u>	<u>Push On/ Push Off switch</u>	<u>Front dash or side console</u>	<u>Temporary overrides engine idle ATC derate</u>	<u>Blinking ATC Tell-Tale light</u>
<u>Switch</u>	<u>On/Off toggle switch</u>	<u>Side console</u>	<u>Turns off the "Stop Request" chime</u>	
<u>Switch</u>	<u>Volume switch</u>	<u>Side console</u>	<u>Controls the volume of the "Stop Request" chime</u>	
<u>Connect System</u>			<u>Remote diagnostics. Reduces road calls.</u>	
<u>No Adjustable Chime</u>		<u>Mounted behind driver on forward side of the SDS enclosure</u>	<u>Outputs 83DBA when measured at a distance of 18"</u>	

4. Indicate area by drawing. Break up switch control from indicator lights.

TABLE 6 (ALTERNATIVE (APPROVED), Transit Coach)
Transit Bus Instruments and Alarms

Device	Description	Location	Function	Visual/Audible
<i>Control switches for 3 extra Fans (6 in. dia.) (in approved location)</i>	<i>2 or 3 switches, 3 position (Off, High, Low)</i>	<i>In approved location</i>	<i>extra Fans (6 in. dia.) (in approved location) to assist windshield defroster</i>	

<i>Additional "Stop Requested" Indicator Light</i>	<i>LED indicator</i>	<i>Front Dash--to be HIGHLY visible to the driver</i>	<i>Additional, highly visible "Stop Requested" tell-tale light</i>	<i>Large Amber LED, independently dimmable</i>
<i>Dimmer knob for additional "stop Requested" LED Indicator</i>	<i>Dimmer Knob</i>	<i>Front Dash next to the additional LED Indicator</i>	<i>Controls the brightness of the additional "Stop Requested" tell-tale light during bright sun light or night time.</i>	<i><u>Independent of regular dimmer dash knob</u></i>

TS 46.6 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.

TS 46.6.1 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 deg at the point of initiation of contact and extend downward to an angle of 10 to 18 deg 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.

TS 46.6.2 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.

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.

TS 46.7 Brake and Accelerator Pedals

ALTERNATIVE-----APPROVED

Adjustable Brake and Accelerator Pedals The Agency requests this be a part of the base bus price.

Both pedals shall be adjustable forward and rearward a minimum of 3 in. The adjustment shall be made by use of a dash-mounted toggle or rocker switch. The switch shall be clearly labeled to identify it as pedal adjustment and shall be within easy reach of the driver. Pedal adjustment shall be enabled only when the bus is stationary and the parking brake engaged.

The Konsberg Pedals have been APPROVED.

TS 46.8 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 deg and a maximum of 37 deg. It shall be located no closer to the seat front than the heel point of the accelerator pedal.

DEFAULT-----APPROVED

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 and public address system, shall be in approved locations.

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, while those for ~~the PA system and~~ the high beam shall be latching type. The spacing of the switches (*minimum 5" between Turn Signal Switches*) shall be such that inadvertent simultaneous deflection of switches is prevented.

ALTERNATIVE-----APPROVED

Other Floor-Mounted Controls

The following may be floor mounted, momentary or latching, **as identified by the Agency**:

- Hazard *mounted on operator's side panel.*
- Silent Alarm *harness and heel operated switch shall be provided by the Agency, installed by the Contractor on the floor in front of the operator's seat.*
- PA System *Clam-Shell Switch shall be a vendor supplied momentary switch, mounted to the floor next to the rear left-side of the steering column. Exact location TBD.*
- *High Beam Switch to be mounted between and slightly above the two Turn Signal Switches.*

An inclined stainless steel mounting surface, but not skid resistant is Approved.

TS 47. Driver's Amenities

TS 47.1 Coat Hanger

ALTERNATIVE-----APPROVED

Coat Hook

A hook and loop shall be provided to secure the driver's coat. **Location TBD**

TS 47.2 Drink Holder

ALTERNATIVE-----APPROVED

Drink Holder

A device shall be provided to securely hold the driver's drink container, which may vary widely in diameter. It must be mounted within easy reach of the driver and must have sufficient vertical clearance for easy

removal of the container. When the container is in the device, the driver's view of the road must not be obstructed, and leakage from the container must not fall on any switches, gauges or controls. Requires approval by the Agency.

TS 47.3 Storage Box

DEFAULT-----APPROVED

Storage Box

An enclosed driver storage area shall be provided with a positive latching door and/or lock. The minimum size is 2750 in.³

A Storage box above the seated driver: 12"H x 13-19"L x 9W (~1728 in.3) along with a Storage box behind the seated driver: 12"H x 19"L x 7"W (~1596 in.3) is approved with the condition that both storage boxes are installed.

TS 47.4 Garbage Cans and Mount

Provide two (2) plastic, beige colored, 8 quart, garbage cans and one (1) stainless steel garbage can mount. Location TBD.



*A Rubbermaid #2952 plastic garbage can has been **APPROVED**.*

TS 48. Windshield Wipers and Washers

TS 48.1 Windshield Wipers

The bus shall be equipped with a windshield wiper for each half of the windshield. 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

DEFAULT-----APPROVED

Single-control, electric two-speed intermittent wiper.

ALTERNATIVE-----APPROVED

Intermittent Wiper with Variable Control

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.

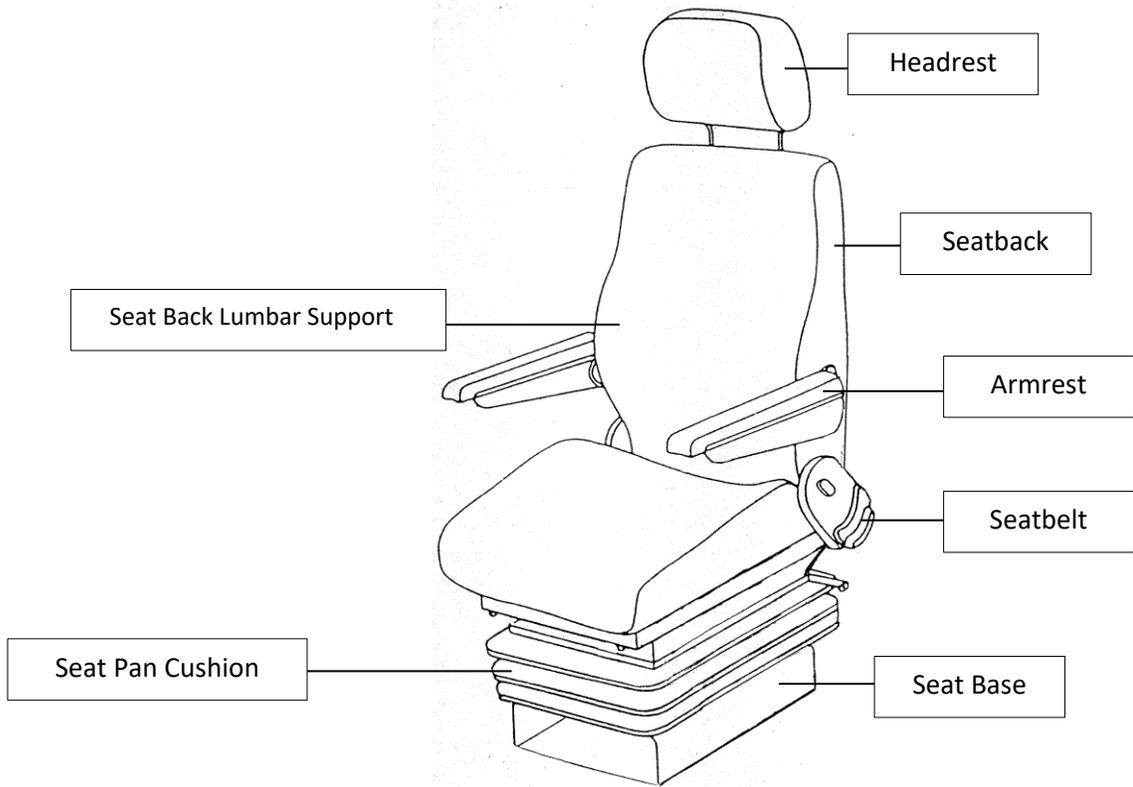
TS 48.2 Windshield Washers

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 the bus. Reservoir pumps, lines and fittings shall be corrosion-resistant and must include a means to determine fluid level.

TS 49. Driver's Seat

FIGURE 5
Driver's Seat



TS 49.1 Dimensions

The driver’s seat shall be comfortable and adjustable so that people ranging in size from a 95th-percentile male to a 5th-percentile female may operate the bus.

TS 49.1.1 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.

SP 12.1.1 Seat Pan Cushion Height

DEFAULT-----APPROVED

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.

TS 49.1.2 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 deg). The seat pan shall adjust in its slope from no less than plus 12 deg (rearward “bucket seat” incline) to no less than minus 5 deg (forward slope).

TS 49.1.3 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 1/2 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.

TS 49.1.4 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.

TS 49.1.5 Seat Suspension

The driver’s seat shall be appropriately dampened to support a minimum weight of 380 lbs. The suspension shall be capable of dampening adjustment in both directions.

Rubber bumpers shall be provided to prevent metal-to-metal contact.

TS 49.1.6 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.

TS 49.1.7 Headrests

DEFAULT-----APPROVED

Adjustable headrest.

TS 49.1.8 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.

TS 49.1.9 Seat Back Angle Adjustment

The seat back angle shall be measured relative to a level seat pan, where 90 deg is the upright position and 90 deg-plus represents the amount of recline.

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

TS 49.2 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 seatbelt assemblies as installed in the bus shall withstand static horizontal forces as required in FMVSS 207 and 210.

DEFAULT-----APPROVED

Lap seat belt only. *Mount the lap seat belt Retractor on the street-side of the operator's seat.*

DEFAULT-----APPROVED

Seatbelt webbing shall be black in color.

ALTERNATIVE-----APPROVED

All seatbelt assemblies shall come equipped with a warning switch device (*buzzer and light*) to remind operators to buckle up.

Lap Belt Length

ALTERNATIVE-----APPROVED

72 in. with Extension

The lap belt assembly shall be 72 in. in length with an 8 in. extension

TS 49.3 Adjustable Armrest

ALTERNATIVE-----APPROVED

One armrest, right side.

TS 49.4 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.

TS 49.5 Seat Structure and Materials

Cushion

Cushions shall be fully padded with at least 3 in. of materials in the seating areas at the bottom and back.

See TS 49.7 Seat Options for Approvals

Cushion Materials

DEFAULT-----APPROVED

Open-cell polyurethane (FMVSS 302). **Polyurethane with Liquicell upgrade is approved.**

TS 49.6 Pedestal

DEFAULT-----APPROVED

Powder-coated steel. ~~Stainless steel~~

TS 49.7 Seat Options

Choose among the following:

- heated seat
- seat alarm
- fabric options-----**APPROVED, Transit grade black vinyl**
- seat air vent
- side bolsters adjustments-----**APPROVED with Transit grade black vinyl Bolsters**
- silicone seat cushion
- **LiquiCell-----APPROVED**
- **Adjustable Thigh Cushion-----APPROVED**

The Ergo Metro AM80 has been APPROVED.

TS 49.8 Mirrors

TS 49.8.1 Exterior Mirrors

The bus shall be equipped with 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.

ALTERNATIVE-----APPROVED

Exterior mirrors shall be installed with a breakaway mounting system.

ALTERNATIVE-----APPROVED

Spring-loaded mirror heads auto return. ***The Agency request the Auto Return be part of the base bus price.***

Spring back mounted mirrors are APPROVED.

ALTERNATIVE-----APPROVED

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

*Provide a High Mounted exterior **Curb-side**, hanging down, single mirror housing with an upper flat and a lower convex mirror, both heated and remotely adjusted. Use a minimum 10" w x 9" h flat mirror and a minimum 10" w x 5.5" h convex mirror.*

*Provide a Low Mounted exterior **Street-side**, pointing up, single mirror housing with an upper flat and a lower convex mirror, both heated and remotely adjusted. Use a minimum 10" w x 8" h flat mirror and a minimum 10" w x 4" h convex mirror.*

*A Hadley mirror housing of 10" x 16" inclosing a flat mirror of 10" w x 9" h and a convex mirror of 10" w x 5.5" h (convex located under the flat mirror) for the **Curb-side** has been **APPROVED**. These large dimensions are critical for removing blind spots and for good rear side vision.*

*A Hadley mirror housing of 10" x 13" inclosing a flat mirror of 10" w x 8" h and a convex mirror of 10" w x 4" h (convex located under the flat mirror) for the **Street-side** has been **APPROVED**. These large dimensions are critical for removing blind spots and for good rear side vision.*

The Hadley 9x13 2/1 Dual Remove and Heated Mirrors are Acceptable but larger mirrors above are preferred. Mirror should include a ball and collet mechanism to allow for tilt up and down adjustment.

TS 49.8.1 Curbside Mirrors

The curbside 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 mirror configuration requests.

The curb-side exterior mirror housing which includes the flat and convex mirrors is to be seen within the windshield or window wiper sweep area by a 95th percentile male sitting comfortably in an adjusted operator's seat.

DEFAULT-----APPROVED

Remote Adjustment of Curbside Mirror

The driver shall be able to adjust the curbside mirror remotely while seated in the driving position. The control for remote positioning of the mirror shall be a single switch or device. Provide a single joy stick switch without a neutral switch position for adjusting both the flat mirror and convex mirror with-in a single housing. Use a molded weatherproof 9 pin connector for connecting the mirror wires to the bus.

ALTERNATIVE-----APPROVED

Heated and Remote Mirrors

The heaters shall be energized whenever the driver's heater and/or defroster is activated or activated independently. One (1) switch on the driver's side dash shall activate the heat for ALL Street-side and Curb-side mirrors.

Activate both curb-side and street-side flat and convex mirror heaters using one momentary dash switch with a 15 minute shutdown timer.

Street-Side Mirrors

ALTERNATIVE-----APPROVED

Remote Adjustment of ~~Curbside~~ Street-side Mirror

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

Provide a single joy stick switch without a neutral switch position for adjusting both the flat mirror and convex mirror with-in a single housing. Use a molded weatherproof 9 pin connector for connecting the mirror wires to the bus.

ALTERNATIVE -----APPROVED

Heated Street-Side Mirrors

The street-side mirrors shall have heaters that energize whenever the driver's heater and/or defroster is activated, or can be activated independently.

See "Alternative---Heated and Remote Mirrors" above.

Provide a rear back-up camera which automatically turns "on" when the bus is backed up. Provide an automatic full screen visual on the dash Multifunctional Display (Minimum 7" screen). This is a non-recorded visual tool for the operator when backing the bus.

A Safety Vision rear bus camera with a metal guard has been **APPROVED**.

TS 49.8.2 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 (if applicable), anywhere in the aisle, behind the street-side front wheel housing and in the rear seats. Use a minimum 8" x 16" convex rear view mirror mounted below the destination sign to observe the interior of the bus. Provide the ability to adjust this mirror horizontally or vertically. Provide a 6" flat adjustable mirror attached to the destination sign cabinet, pointed at the seats behind the street-side front wheel housing.

Provide a 6" flat adjustable mirror attached to the destination sign cabinet, pointed at the 12" round mirror located at the rear exit door.

Standard mirror that is 8" x 15" is APPROVED.

Lucerix p/n 271960 which as "ball type" joint for adjustment in all directions is APPROVED.

WINDOWS

TS 50. General

Use with 30ft length: A minimum of 6000 sq in. of window area, including operator and door windows, shall be required on each side of the standard configuration bus.

Use with 35ft length: A minimum of 8000 sq in. of window area, including operator and door windows, shall be required on each side of the standard configuration bus.

Use with 40ft length: A minimum of 10,000 sq in. of window area, including operator and door windows, shall be required on each side of the standard configuration bus.

Use with 45ft length: A minimum of 12,000 sq in. of window area, including operator and door windows, shall be required on each side of the standard configuration bus.

~~Use with 60ft length: A minimum of 16,000 sq in. of window area, including operator and door windows, shall be required on each side of the standard configuration bus.~~

TS 51. 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 deg, 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 deg above the line of sight. Any binocular obscuration due to a center divider may be ignored when determining the 90 deg requirement, provided that the divider does not exceed a 3 deg angle in the operator's field of view. Windshield pillars shall not exceed 10 deg of binocular obscuration. The windshield shall be designed and installed to minimize external glare as well as reflections from inside the bus.

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.

TS 51.1 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 AS-1 and the recommended practices defined in SAE J673.

DEFAULT-----APPROVED

Shaded Band The upper portion of the windshield above the driver's field of view shall have a dark, shaded band and marked AS-3, with a minimum luminous transmittance of 5 percent when tested in accordance to ASTM D- 1003

The shaded band shall extend to the winglets on both sides of the bus, including the entrance door top window and the operator's side window. The shaded band for the side window and upper door window may be a decal that is no darker than the windshield shaded band.

DEFAULT-----APPROVED

Two-piece windshield. *Preferred because a rock chip can crack only ½ of the windshield resulting in less windshield replacement expense.*

TS 52. Driver's Side Window

The driver's side window shall be the sliding type, requiring only the rear half of the sash to latch upon closing, and *the front half of the sash* shall open sufficiently to permit the seated operator to easily adjust the street-side outside rearview mirror. *The front half of the sash shall have an inside and outside handle and shall not have a latch to prevent the opening or closing of the window.* 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 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.

ALTERNATIVE-----APPROVED

The driver's side window glazing material shall have a ¼ in. nominal thickness tempered safety glass conforming to the requirements of ANSI Z26.1-1996 Test Grouping AS-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.

ALTERNATIVE-----APPROVED

Hidden Frame (Flush “Euro-Look”) Driver’s Side Window

Agency to choose from the following options:

- full slider
 - egress
 - non-egress-----APPROVED
- top fixed over bottom slider
 - egress
 - non-egress

ALTERNATIVE-----APPROVED

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.

TS 53. Side Windows

TS 53.1 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 drivetrain operation or normal road excitation is not apparent. All aluminum and steel material will be treated to prevent corrosion.

TS 53.2 Emergency Exit (Egress) Configuration

DEFAULT-----APPROVED

Minimum Egress

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

DEFAULT-----APPROVED

Standard Passenger Side Window Configurations

Agency to choose from the following options:

- traditional frame
 - full fixed
 - openable windows with inward-opening transom panels
 - openable windows with sliding transom panels

- openable windows with a fixed transom panel and sliding lower panels
- openable windows with full-height sliding panels
- hidden frame (flush “Euro-look”)
- full fixed
- openable windows with inward-opening transom panels
- fixed lower panel with inward-opening upper transom panel -----APPROVED

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.

ALTERNATIVE-----APPROVED

Hidden Frame (Seamless)

Agency to choose from the following options:

- full fixed
- openable windows with inward-opening transom panels
- fixed windows with inward-opening transom panels

The Agency has approved in the base bus price “Fixed lower panel with inward opening upper transom panels” only. It is the only bullet point with APPROVED listed directly next to it in the section listed above.

TS 53.3 Configuration

DEFAULT-----APPROVED

Fixed Side Windows

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

ALTERNATIVE-----APPROVED

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 and open inward.

Transom panels to be held open or closed with gas springs.

TS 53.4 Materials

DEFAULT-----APPROVED

Safety Glass Glazing Panels

Side windows glazing material 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.

DEFAULT-----APPROVED

Windows on the bus sides and in the rear door shall be tinted a neutral *gray* 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.

DEFAULT (LIGHT) -----APPROVED

55 percent luminous transmittance.

5mm tempered (per spec) glass which comes in 50% LT is APPROVED.

Flush windows manufactured by Arrow Global are APPROVED

NOTE: All glass treatments must be permanent, within the glass and/or in the center membrane. Surface films are not permitted.

SHGC and light transmission performance shall be defined by the National Fenestration Rating Council.

TS 53.5 Rear Window

DEFAULT-----APPROVED

No requirement for rear window.

TS 54 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.

DEFAULT-----APPROVED

HVAC equipped. See below for configuration.

No Requirements for Cooling

All requirements relevant to the HVAC cooling mode contained in this section, as well as throughout this specification, need not apply. All other requirements for heating and ventilation still apply.

DEFAULT-----APPROVED

Allow Either Roof- or Rear-Mounted HVAC Unit

The HVAC unit may either be roof or rear-mounted. Note that a rear-mounted unit will preclude a rear

window and that the term “roof-mounted unit” includes units mounted on top of or beneath the roof surface. **Base bus price to include the recommended configuration for electric propulsion powertrain. R-134a refrigerant is APPROVED.**

ALTERNATIVE -----APPROVED

Fully AC high-voltage electric-driven A/C system with full hermetic AC compressor, condenser fan, evaporator blower motors ~~and brushless AC generators.~~

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 °F for each degree of exterior temperature in excess of 95 °F.

When the 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 APTA’s *Recommended Practice* “Transit Bus HVAC System Instrumentation and Performance Testing.”

NOTE: The recommended locations of temperature probes are only guidelines and may require slight modifications to address actual bus design. Care must be taken to avoid placement of sensing devices in the immediate path of an air duct outlet. In general, the locations are intended to accurately represent the interior passenger area.

Additional testing shall be performed as necessary to ensure compliance to performance requirements stated herein.

ALTERNATIVE-----APPROVED

Hotter Ambient Conditions

The air conditioning portion of the HVAC system shall be capable of reducing the passenger compartment temperature from 110 to 70 °F ± 3 °F in less than 30 minutes after system engagement for 30, 35 and 40 ft buses. ~~Engine~~ coolant 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 at three-quarters max governed speed that 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. No simulated solar load shall be used. There shall be no passengers on board, and the doors and windows shall be closed.

ALTERNATIVE-----APPROVED

Colder Ambient Conditions

The pull-up requirements for the heating system shall be in accordance with Section 11.1 of APTA's *Recommended Practice* "Transit Bus HVAC System Instrumentation and Performance Testing." With ambient temperature at -20 °F, and vehicle cold soaked at that temperature, the bus heating system shall warm the interior passenger compartment to an average temperature of 70 °F ±2 °F within 70 minutes.

ALTERNATIVE-----APPROVED

R134a

The air conditioning system shall meet these performance requirements using R134a. [Note that selection of this refrigerant may impact pull-down performance.]

TS 54.1 Other HVAC Performance Specifications

If applicable, provide an a/c compressor oil sample port (Shrader Valve) on the compressor for taking oil samples.

The compressor shall have suction and discharge convoluted SSTL refrigerant hoses covered with a stainless steel braid and with welded fittings.

Provide a "reheat" option instead of the "cycling clutch" option.

*Provide two (2) electronic pressure gauges in the air-return compartment. A **Electronic Pressure Display module in place of the Electronic Pressure Gauges is Approved.***

Use copper Type "K" hard copper lines with brazed or silver soldered connections.

*A Thermo King HVAC system has been **APPROVED.***

TS 55. 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.

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 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.

ALTERNATIVE-----APPROVED

Fully Automatic Climate Control System

The climate control system shall be fully automatic and control the interior average temperature to within ± 2 °F of specified temperature control setpoint.

ALTERNATIVE-----APPROVED

Manually Adjustable Temperature Control Set Point

The climate control system shall have the provision to allow the driver to adjust the temperature control setpoint at a minimum of between ~~68~~ 62 and ~~72~~ 78°F. From then on, all interior climate control system requirements shall be attained automatically, unless re-adjusted by the driver.

The driver shall have full control over the defroster and driver's heater. The driver shall be able to adjust the temperature in the driver's area through air distribution and fans. The interior climate control system shall switch automatically to the ventilating mode if the refrigerant compressor or condenser fan fails.

Interior temperature distribution shall be uniform to the extent practicable to prevent hot and/or cold spots. After stabilization with doors closed, the temperatures between any two points in the passenger compartment in the same vertical plane, and 6 to 72 in. above the floor, shall not vary by more than 5 °F with doors closed. The interior temperatures, measured at the same height above the floor, shall not vary more than ± 5 °F from the front to the rear from the average temperature determined in accordance with APTA's "Recommended Instrumentation and Performance Testing for Transit Bus Air Conditioning System." Variations of greater than ± 5 °F will be allowed for limited, localized areas provided that the majority of the measured temperatures fall within the specified requirement.

TS 55.1 Auxiliary Heater

ALTERNATIVE-----APPROVED

Auxiliary Heater

An auxiliary heater fired by diesel fuel shall be provided to supplement the heat supplied by the ~~engine~~ Electric propulsion system, and shall have an output necessary (minimum of 30,0000 btu) to meet the performance criteria. The heater shall be equipped with safety devices to prevent overfueling, overheating due to loss of coolant or water pump failure, and operation during conditions of low battery voltage. ~~The auxiliary heater shall have capability of functioning in the supplemental mode and preheat mode.~~ Provide a toggle switch located to the left of the bus operator, labeled "Auxiliary Heater" and "Enabled/Off". Provide an amber telltale light next to the switch which lights up when the Auxiliary Heater is operating. The supplemental mode shall automatically cycle the auxiliary heater "on" and "off" according to the coolant temperature. No driver input shall be required when the bus is in operating mode. ~~engine is running.~~ The preheat mode shall be enabled through a single-pole double-throw momentary switch located on the street-side rear corner of the bus, under a weatherproof cap. With the master run switch in the "off" position, toggling the switch to its momentary upward ("on") position shall enable the auxiliary heater to operate in preheat. Once in preheat, the unit shall continue to operate and cycle until either the preheat switch is toggled to its momentary downward ("off")

position, or the master run switch is turned “on,” or the time elapsed exceeds 60 minutes, at which time the preheat mode will automatically be disabled. The supplement mode will always override the preheat mode. The auxiliary heater coolant pump shall shut down when the coolant is up to temperature during the supplemental mode. With the bus is in operating mode, engine running, there shall be coolant flow through the heater all the time. The temperature sensor shall constantly measure the coolant temperature and cycle “on” if required, at which time the coolant pump turns on. The Auxiliary Heater shall obtain air for combustion somewhere other than inside the rear propulsion system compartment or from behind the bus tires The proposers shall state where and how the relatively clean combustion air will be obtained and delivered to the Auxiliary Heater.

Provide a variable BTU type auxiliary heater. The Proheat X30 31k BTU heater is APPROVED

The auxiliary heater shall be equipped with a self-priming fuel pump. The unit shall be electronically controlled with appropriate diagnostics for troubleshooting. Operation, as well as diagnostic data, shall be stored and shall be retrievable through an IBM compatible PC. The auxiliary heater maintenance/diagnostic information shall be communicated through the appropriate protocol, SAE J1708 or J1939.

TS 56. Air Flow

TS 56.1 Passenger Area

The cooling mode of the interior climate control system shall introduce air into the bus at or near the ceiling height at a minimum rate of 25 cubic ft per minute (cfm) per passenger based on the standard configuration bus carrying a number of passengers equal to 150 percent of the seated load. Airflow shall be evenly distributed throughout the bus, with air velocity not exceeding 100 ft per minute on any passenger. The ventilating mode shall provide air at a minimum flow rate of 20 cfm per passenger.

Airflow may be reduced to 15 cfm per passenger (150 percent of seated load) when operating in the heating mode. The fans shall not activate until the heating element has warmed sufficiently to ensure at least 70 °F air outlet temperature. The heating air outlet temperature shall not exceed 120 °F under any normal operating conditions.

The climate control blower motors and fan shall be designed such that their operation complies with the interior noise level requirements.

DEFAULT-----APPROVED

No “Fresh Air” Requirements

To be used by agencies that have an operating profile where the door opening cycle results in effectively providing an adequate “fresh air” mixture.

TS 56.2 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.

TS 56.3 Controls for the Operator's 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 manually operated control valve shall control the coolant flow through the heater core.
- If a cable-operated manual control valve is used, then the cable length shall be kept to a minimum to reduce cable seizing. 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.**

TS 56.4 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 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. All decals are to be a permanent part of the dash. When closed, vents shall be sealed to prevent the migration of water or air into the bus.

TS 56.5 Driver's Cooling

DEFAULT-----APPROVED

No dedicated evaporator.

ALTERNATIVE

Separate Dedicated Evaporator

Using a separate, dedicated evaporator, the climate control system shall be designed to maintain the driver's compartment temperatures within the range specified for the passenger compartment. The unit shall operate when the climate control switch is in the "Cool" position. It shall have a separate thermostatic control.

ALTERNATIVE

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.

ALTERNATIVE-----APPROVED

Driver’s booster blower.

TS 56.6 Three (3) additional Dash Fans

Provide an additional three (3) black fans (6” in diameter) to be mounted under the destination sign compartment. Provide fans with a heavy duty bolt & hinge swivel as opposed to a light duty ball & socket swivel. The purpose for these fans is to assist the defroster when removing fog and condensation from the windshield, window winglets, operator’s side window and front door. The preferred fan mounting locations are the upper left corner of the streetside windshield, the top center between both windshields and the top center of the curbside windshield. Provide 2 or 3 switches on the dash with High/Low/Off for fan control. Location TBD. Approval is provided to work with the Agency to find the best solution based on the front windshield/dash design.

TS 57. Air Filtration

Air shall be filtered before entering the AC system and being discharged 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.

ALTERNATIVE-----APPROVED

Other Type Filters

Air filters shall be made out of cleanable, electrostatic mesh.

A Polypropylene Electrostatic Mesh cleanable filter has been **APPROVED**.

TS 58. Roof Ventilators

Each 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.

Clarification – One roof hatch is required.

DEFAULT-----APPROVED

One Roof Ventilator

One ventilator shall be provided in the roof of the bus.

Provide a cable to physically attach the escape hatch lid to the roof of the bus.

ALTERNATIVE-----APPROVED

A tool shall be provided to manually open and close the hatch.

TS 59. 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.

DEFAULT-----APPROVED

High and low refrigerant pressure electronic gauges to be located in the return air area.

NOTE: The Agency may include the following sections if an alternative for colder ambient performance is specified above.

TS 60. Entrance/Exit Area Heating

ALTERNATIVE-----APPROVED

Entrance/Exit Area Heating

Heat (*hot air*) shall be supplied to the entrance and exit areas to maintain a tread surface temperature no less than 35 °F in an ambient of -10 °F to prevent accumulation of snow, ice or slush with the bus operating under design operating profile and corresponding door opening cycle of the Transit Buses.

TS 61. Floor-Level Heating

TS 61.1 Transit Coach

ALTERNATIVE-----APPROVED for Transit Buses

Floor-Level Heating

Sufficient floor-level heaters shall be provided to evenly supply heated forced air. Control of the floor-level heating shall be through the main heating system electronic control.

TS 61.2 Commuter Coach

EXTERIOR PANELS, FINISHES AND EXTERIOR LIGHTING

TS 62. Design

The bus shall have a clean, smooth, simple design, primarily derived from bus performance requirements and passenger service criteria. 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.

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.

TS 62.1 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.

DEFAULT-----<u>APPROVED</u>

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

TS 62.2 Roof-Mounted Equipment (Transit Coach)

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. Provide an emergency fall protection clip-ring associated with each type of roof mounted equipment (a/c components, CNG tanks, etc.).

TS 63. Pedestrian Safety

Exterior protrusions along the side and front of the bus greater than ½ in. and within 80 in. of the ground shall have a radius no less than the amount of the protrusion. 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.

TS 64. Repair and Replacement

TS 64.1 Side Body Panels (Transit Coach)

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.

ALTERNATIVE-----APPROVED

Easily Replaceable Full-Height Side Body Panels

Full-height side body panels between the window and floor shall be easily and quickly replaceable in sections.

~~TS 64.2 Side Body Panels (Commuter Coach)~~

TS 65. 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.

TS 66. License Plate Provisions

Provisions shall be made to mount standard-size U.S./Canada license plates per SAE J686 on the front and rear of the bus. These provisions shall direct-mount or recess the license plates so that they can be cleaned by automatic bus-washing equipment without being caught by the brushes. The rear license plate provision shall be illuminated per SAE J587.

ALTERNATIVE-----APPROVED

Front Plate or Holder is Required

Location to be provided to OEM.

Provide a recessed rear license plate mount with an LED light.

TS 66.1 Rub rails

DEFAULT-----APPROVED

No requirement for rub rails.

The rub rail may be discontinued at doorways, wheel wells and articulated joints if applicable. A damaged portion of the rub rail shall be replaceable without requiring removal or replacement of the entire rub rail.

NOTE: Installation of rub rails may preclude the installation and/or size of exterior advertising signs or racks.

TS 67. Fender Skirts

DEFAULT-----APPROVED

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.

TS 68. Wheel Covers (Transit Coach)

DEFAULT-----APPROVED

Wheel covers not required.

TS 68.1 Splash Aprons

DEFAULT-----APPROVED

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 to protect under floor components. The splash aprons shall extend downward to within 6 in. off the road surface at static conditions. Apron widths shall be no less than tire widths. 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.

ALTERNATIVE (TRANSIT COACH)-----APPROVED

Full width rear splash apron.

ALTERNATIVE-----APPROVED

Other Locations Required

Splash apron in front of either or both front wheels to reduce splashing on ramp/lift and left mirror.

TS 69. Exterior Service Compartments and Access Doors

TS 69.1 Access Doors (Transit Coach)

Conventional or pantograph hinged doors shall be used for the electric drive compartment and for all auxiliary equipment compartments, including doors for checking the quantity and adding to the ~~engine~~ engine coolant, ~~engine~~ engine lubricants 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.

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

Depot Charger connection ports: Bus shall include 2 depot charger connection ports preferably at the front and rear to allow two buses to charge on one depot charger at a time parked front to back. If front and back is not available, provide two ports on either side of the bus.

TS 69.2 Access Doors (Commuter Coach)

TS 69.3 Access Door Latch/Locks

DEFAULT-----APPROVED

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 **plug in charger** 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.

The large rear electric drivetrain access door is not required to have locks. Attach a large grab handle to the access door and use non-locking, over-center gas springs to hold the engine access door open or closed. A handle on the rear electric drivetrain access door that is recessed at the bottom of the door is APPROVED.

ALTERNATIVE-----APPROVED

Other Locks and Latches

Agency may define any required locks or latches for access doors.

Use barrel locks for A/C access doors and other sensitive areas. Use tumbler lock(s) and barrel locks on the Electronic/Radio Compartment door. Use a push latch for the operator's storage compartment door.

TS 70. Bumpers

TS 70.1 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.

TS 70.2 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 deg 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. Do not paint the naturally black bumper.

A front bumper height of 24 inches (610 mm) at the center line of the bus and a height at the outer edges of 27 inches (686 mm) from the street level at ride height is Approved.

ALTERNATIVE-----APPROVED

Mounting provisions for integrated bike rack.

The “through the bumper” Apex3 bike rack front bumper mount from Sportworks has been **APPROVED**.

DEFAULT-----APPROVED

Standard bumper.

TS 70.2.1 Bike Rack

Install a bike rack on the front bumper that will support 3 bicycles. The bike rack tubing cannot be located exactly in front of headlights or turn signals in a raised or lowered position. Therefore, the high beam light center-to-center, is to be a minimum of 70 inches and low beam center-to-center, is to be a minimum of 81 inches. The bike rack shall be made out of brushed stainless steel. Use no paint.

A Sportworks Apex3 bike rack has been approved.

TS 70.3 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 deg 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 70 in. Do not paint the naturally black bumper.

TS 70.4 Bumper Material

Bumper material shall be corrosion-resistant and withstand repeated impacts of the specified loads without sustaining damage. These bumper qualities shall be sustained throughout the service life of the bus.

TS 71. Finish and Color

TS 71.1 Appearance

All exterior surfaces shall be smooth and free of wrinkles and dents. Exterior surfaces to be painted shall be properly prepared as required by the paint system Supplier prior to application of paint to ensure a proper

bond between the basic surface and successive coats of original paint for the service life of the bus. Drilled holes and cutouts in exterior surfaces shall be made prior to cleaning, priming and painting, where possible, to prevent corrosion. The bus shall be painted prior to installation of exterior lights, windows, mirrors and other items that are applied to the exterior of the bus. Body filler materials may be used for surface dressing, but not for repair of damaged or improperly fitted panels.

Paint shall be applied smoothly and evenly with the finished surface free of visible dirt and the following other imperfections:

- blisters or bubbles appearing in the topcoat film
- chips, scratches or gouges of the surface finish
- cracks in the paint film
- craters where paint failed to cover due to surface contamination
- overspray
- peeling
- runs or sags from excessive flow and failure to adhere uniformly to the surface
- chemical stains and water spots
- dry patches due to incorrect mixing of paint activators
- buffing swirls

All exterior finished surfaces shall be impervious to diesel fuel, gasoline and commercial cleaning agents. Finished surfaces shall resist damage by controlled applications of commonly used graffiti-removing chemicals.

Proper adhesion between the basic surface and successive coats of the original paint shall be measured using an Elcometer adhesion tester as outlined in ASTM D4541-85. Adhesion shall be a minimum 300 ft-lbs. The bus manufacturer shall supply test samples of the exterior surface for each step of the painting process that may be subject to adhesion testing per ASTM G4541-87 and ASTM D4145-85. ASTM D4541-93 may be used for inspection testing during assembly of the vehicle.

DEFAULT-----APPROVED

Standard Contractor exterior paint finish quality.

ALTERNATIVE

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."

DEFAULT

Base coat/clear coat paint system.

ALTERNATIVE-----APPROVED

Standard OEM exterior paint system.

ALTERNATIVE

Maintenance-Free Exterior Finish, Color Impregnated Panels or Unpainted Panels

Except for periodic cleaning, exterior surfaces of the bus shall be maintenance free, permanently colored and not require refinish/repaint for the life of the vehicle. In general, the exterior surfaces shall be white. Durable, peel-resistant, pressure-sensitive appliquéés shall be used for any striping and coloring required.

NOTE: The Agency should insert approved paints, color scheme and graphics.

The following brand of material has been APPROVED for color, color durability, and material durability.

1. UTA's Logos
 - 3M White Scotchlite = #280-10
 - 3M Ruby Red Scotchlite = #280-82
 - 3M Blue Scotchlite = #280-75

2. The Authority's logo shall be located in the front, both sides, and rear of the bus. A copy of UTA's logo will be sent to the successful proposer.

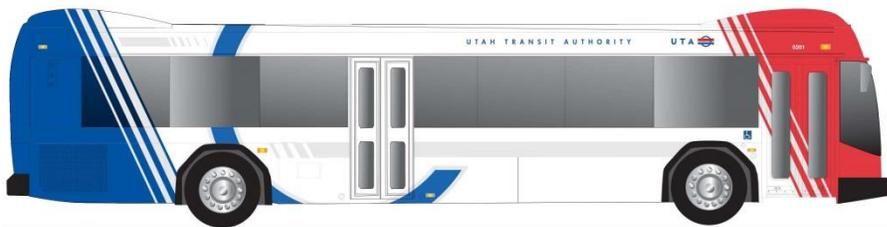
3. Four exterior bus numbers, four-inch high, white or black decals, are to be installed. Exact location TBD.
 - On the front of the bus
 - On the rear of the bus
 - On the street-side of the bus above the driver's window
 - On the curb-side of bus above the front entrance door
 - Use 3M White Scotchlite #280-10,
 - Use 3M Black Scotchlite #285-85,

4. Install one interior bus number – four (4) inches high – white or black, located on the center of the front destination sign door.

5. The style of both the interior and exterior numbers shall be Helvetica Medium.

5. The bus numbers shall be numbered consecutively from #XXXXX through #XXXXX ...TBD

The paint scheme shown below is for illustration only. Details will be provided to the successful vendor.



Dupont Imron 5000 Paint Colors: White Base 735085-EX
Blue 777407-EX
Red 777406-EX
Black N0001-EX
Color for axle hubs: Silver

TS 72. Decals, Numbering and Signing

Monograms, numbers and other special signing shall be applied to the inside and outside of the bus as required. Signs shall be durable and fade-, chip- and peel-resistant. They may be painted signs, decals or pressure-sensitive appliques. All decals shall be installed per the decal Supplier recommendations. Signs shall be provided in compliance with the ADA requirements defined in 49 CFR Part 38, Subpart B, 38.27.

NOTE: The Agency should supply a list of interior and exterior decals including size and location.

Provide signs and decals in English and Spanish for the passengers. Include the following if they apply to this bus purchase. If the Proposer desires to use their decals, they will need to be reviewed and accepted by the Procuring Agency:

Watch your step - Tenga Cuidado al Caminar; Caution, Do Not Cross in Front of the Bus - Advertencia, No se Cruce Delante del Autobús; Remain Behind the Yellow Line until the Bus Stops-Permanezca Detras De La

Linea Amarilla hasta que el Autobús se Detenga; Do Not Talk to the Operator While the Bus is in Motion - No Hable con el Conductor Mientras el Autobus este en Marcha; Emergency Door Release, (1) Lift Cover, Push Button, (2) Pull Handles on Doors to Open - Para Abrir la Puerta de Emergencia, (1) Levante la tapa y Oprima el Botoñ, (2) TIRE de las Manijas que hay en Las Puertas); Emergency Door -Puerta de Emergencia; Mobility Aid Securement Location-Area Designada para las Sillas de Ruedas; Push Button to Signal Driver to Stop- Presione el Botoñ Para Indicarle al Conductor que Pare; Pull Cord to Signal Driver to Stop-Tire de la Cuerda para Indicarle al Conductor que Pare; It is a Violation of Federal Law to Operate Bus with Passengers in Prohibited Areas-Conducir un Autobus con Pasajeros en Areas Prohibidas va Contra las Leyes Federales; Emergency Exit-Salida De Emergencia,;Pull Out and Down on Red Handle and Push Window Out-Primero Saque Y Tire Hacia Bajo la Manija Roja Después Empuje la Ventana Hacia Fuera; Priority Seating for Passengers with Disabilities-Cédale Estos Puerstos a los Pasajeros con Discapacidades; Fare Payment Required Upon Boarding-Pague el Costo del Recorrido al Subirse al Autobús; Driver Carries No Change- El Conductor NO lleva Cambio; Disorderly Conduct and or Interfering with the Safe Operation of this Bus Violates State Law and UTA Ordinance. Persons Engaging in Such Conduct Will be Subject to Criminal Punishment and Civil Penalites Utah Code 76-10-1401; UTA Ord. CH. 5, Sec. 3 - El Tener Una Conducta Desordenada Y/O Interferir Con La Seguridad En Este Autobús Va En Contra De Leyes Y Decretos Estatales. La Persona Que Tenga Una Conducta Indeseada Estara Sujeta A Los Castigos Y Multas Correspondientes, LEY 76-10-1401; Decreto, C.5, Sec. 3; Push Here to Close-Empuje Aqui para Cerrar; Keep Feet Off Seats-NO ponga los pies en los asientos; CAUTION: Do Not Stand in Designated Area-Atención: No se Pare en las Áreas Marcadas; Do Not Lean Against Door-NO se Recueste a la Puerta.

ISO Symbol: No Smoking/No Eating/No open Radio playing

Signs and decals for operators and maintenance employees only need to be in English.

Provide a decal on the destination sign door and in front of the operator that shows the height of the vehicle.

TS 72.1 Passenger Information

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

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

TS 73. Exterior Lighting

All exterior lights shall be designed to prevent entry and accumulation of moisture or dust. Lamps, lenses and fixtures shall be interchangeable to the extent practicable. Two hazard lamps at the rear of the bus shall be visible from behind when the engine ~~engine~~ electric drivetrain service doors are opened. Light lenses shall be designed and located to prevent damage when running the vehicle through an automatic bus washer.

DEFAULT-----APPROVED

Commercially available LED-type lamps shall be utilized at all exterior lamp locations.

DEFAULT-----APPROVED

Standard Lamps

All LED lamps shall be standard installation of the OEM. The entire assembly shall be specifically coated to protect the light from chemical and abrasion degradation.

ALTERNATIVE-----APPROVED

Potted Lamps

LED lamps shall be potted type and designed to last the life of the bus.

DEFAULT-----APPROVED

Standard Size

Size of LED lamps used for tail, brake and turn signal lamps shall be standard installation of OEM.
Each LED light shall consist of at least 10 super size diodes.

ALTERNATIVE-----APPROVED

Front marker (clearance) lights along with lights located on the roof and sides of the bus shall have protective shields or be of the flush mount type to protect the lens against minor impacts.

In an effort to reduce rear end accidents, program the turn signals and 4-way flashers so that the flashing pattern is non-typical. This would include something like a pattern where the light illuminates in two short bursts, followed by a pause, then two short bursts, etc.

Low profile lights without guards are Approved.

Turn signal flasher programming TBD pre-production.

TS 73.1 Backup Light/Alarm

Visible and audible warnings shall inform following vehicles or pedestrians of reverse operation. 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.

TS 73.2 Doorway Lighting

LED lamps at the front and rear passenger doorways (if applicable) 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.

TS 73.3 Turn Signals

DEFAULT-----APPROVED

Standard Turn Signals

Turn-signal lights shall be provided on the front, rear, curb and street sides of the bus in accordance with federal regulations. *Provide (2) additional amber turn-signal LED lights in the upper rear corners of the*

bus in addition to the lower mounted turn-signal lights required by federal regulations.

Mirror mounted turn signals

Provide mirror housing mounted LED turn signal lamps

Curbside Corner Lamps

(2) additional Grote Silver Housing LED curb lamps (or similar)required, (1) Low mounted on the Curbside, fwd of REAR wheel with light facing aft and (1) mounted about 5" above the first one on the same panel also facing aft to light up rear wheel area... Lights are activated "solid on" in night run with the right turn signal switch ONLY @ or below 25MPH.. Over25MPH, the light will not be active.

Final layout of curbside light to be Approved by the Agency.

Rear Yield

Data LED, amber, triangular yield sign lamp (or similar) shall be provided on the streetside of the rear HVAC door. Programming for operation of this lamp shall be:

Light will flash when bus is operating with air pressure at normal range, Parking Brake released, Transmission in a forward gear, either door is cycled from the open to closed position, and both doors closed, and the left foot signal is depressed with amber indicator at dash panel 1. Once turn signal switch is released or the multiplexing system senses a speed output (approximately 3MPH), the light will continue to flash for an additional 8 seconds then extinguish.

TS 73.4 Headlights

Headlamps shall be designed for ease of replacement.

ALTERNATIVE-----APPROVED

Daytime Running Lights

Headlamps shall incorporate a daytime running light feature.

ALTERNATIVE-----APPROVED

LED

Headlamps shall be LED/~~halogen, sealed beam~~ lights with extra LED lights pointed to the right and left. The extra lights are to be programmable through the bus multiplex system. Program the extra lights to be 100% bright when when turn signal is activated left or right and 30% bright all other times. **The Agency requests this be a part of the base bus price.**

High and Low Beam Dinex Star LED Adaptive Headlights with Turning Alert have been **APPROVED.**

TS 73.5 Brake Lights

TS 73.5.1 Transit Coach

Brake lights shall be provided in accordance with federal regulations.

ALTERNATIVE-----APPROVED

High and Center Mount Red Brake Lamp

Bus shall include red, *4" LED's in both upper rear corners of the bus or* high and center mount brake lamp(s) (*two 12 inch horizontal LED bars*) along the backside of the bus in addition to the lower brake lamps required under FMVSS. The *high 4" LED's or the* high and center mount brake lamp(s) shall illuminate steadily with brake application. Agency to specify the size of the high and center mount brake lamp(s).

2 – 1x18" strip LED high center mount brake lights located above the electric drivetrain door are approved in lieu of 2 – 12 inch horizontal LED bars.

~~TS 73.5.2 Commuter Coach~~

TS 73.6 Service Area Lighting (Interior and Exterior)

LED lamps shall be provided in the ~~engine~~ *rear electric drivetrain* and all other compartments where service may be required to generally illuminate the area for night emergency repairs or adjustments. These service areas shall include, but not be limited to, the electric drive 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.

Electric drive 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.

INTERIOR PANELS AND FINISHES

TS 74. General Requirements

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.

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. Any components and other electrical components within close proximity to these surfaces shall also be resistant to this cleaning method.

ALTERNATIVE-----APPROVED

Requirements for additional anti-graffiti/vandalism treatments for interior surfaces.

The Agency requests anti-graffiti window film.

TS 75. 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.

DEFAULT-----APPROVED

Interior panel required to meet FMVSS 302.

ALTERNATIVE-----APPROVED

Composite.

ALTERNATIVE-----APPROVED

Scratch-resistant plastic.

ALTERNATIVE-----APPROVED

Melamine-type material.

TS 75.1 Driver Area Barrier

TS 75.1.1 Transit Coach

A barrier or bulkhead between the driver and the street-side front passenger seat shall be provided. The barrier shall minimize glare and reflections in the windshield directly in front of the barrier from interior lighting during night operation. Location and shape must permit full seat travel (***11 horizontal inches***) and reclining possibilities that can accommodate the shoulders of a 95th-percentile male. The partition shall have a side return and stanchion to prevent passengers from reaching the driver by standing behind the driver's seat. The lower area between the seat and panel must be accessible to the driver. The partition must be strong enough in conjunction with the entire partition assembly for mounting of such equipment as flare kits, fire extinguishers (1.2 kg), microcomputer, public address amplifier, etc. The panel should be properly attached to minimize noise and rattles.

Attach a 4" diameter fire extinguisher to the vertical part of the front dash near the fare box. Attach the emergency reflecting triangles to the top of the curb-side wheel housing near the garbage can mount.

*Fire extinguisher located on the driver's barrier is **APPROVED** with the condition that it does not hinder seat adjustment range of motion. Fire extinguisher mounting bracket/kit is to be included in base bus price*

*The Amerex 5 lbs ABC rated fire extinguisher with hose has been **APPROVED**.
The K-D 610-4645 Safety Triangles have been **APPROVED**.*

*Safety triangle kit from ABC is **APPROVED**.*

DEFAULT (TC) -----APPROVED

Wheel-Well-to-Ceiling Configuration of Driver's Barrier

The driver's barrier (*black in color*) 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.

~~TS 75.1.2 Commuter Coach~~

TS 75.2 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 1/2 in. above the floor. Panels forward of longitudinal seats shall extend to below the level of the seat cushion. Dividers positioned at the doorways, where applicable, shall provide no less than a 2 1/2 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 passenger assists are not provided by other means.

The modesty panel and its mounting shall withstand a static force of 250 lbs applied to a 4 x 4 in. area in the center of the panel without permanent visible deformation.

DEFAULT-----APPROVED

Modesty panels shall be installed as stated.

TS 75.3 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. *Color TBD.*

Everything forward of the driver's barrier being black is Approved.

TS 75.4 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. *Color TBD.*

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 liter being thrown or drawn through the grille. If it is necessary to remove the panel to service components located on the rear bulkhead, then 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 use barrel locks to limit unauthorized access.

TS 75.5 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 with barrel locks to prevent inadvertent opening. Color TBD.

TS 75.6 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.

TS 75.7 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 electric drive compartment shall not absorb or retain oils or water and shall be designed to prevent casual damage that may occur during maintenance operations.

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.

ALTERNATIVE-----APPROVED

FMVSS 302

Insulation shall meet the requirements of FMVSS 302.

TS 75.8 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 (deep yellow) and shall extend across the bus aisle. The color and pattern shall be consistent throughout the floor covering.

Any areas on the floor that are not intended for standees, such as areas "swept" during passenger door operation, shall be clearly and permanently marked.

The floor shall be easily cleaned and shall be arranged to minimize debris accumulation.

A one-piece center strip shall extend from the vertical wall of the rear settee between the aisle sides of transverse seats to the standee line. If the floor is of a bi-level construction, then the center strip shall be one piece at each level. 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 door shall extend from the center strip to the outboard edge of the rear/exit area.

The floor under the seats shall be covered with smooth surface flooring material. The floor covering shall closely fit the sidewall in a fully sealed butt joint or extend to the top of the cove.

Provide single color floor covering.

A floor covering has been **APPROVED** using ALTRO, Meta TFM27421 Midnight 2.7mm.

TS 75.9 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.

TS 75.10 Passenger

DEFAULT-----APPROVED

First Row Lights

The first light on each side (behind the driver and the front door) is normally turned on only when the front door is opened, in "night run" and "night park." As soon as the door closes, these lights shall go out. These lights shall be turned on at any time if the switch is in the "on" "All" position.

TS 75.10.1 Modified Passenger Dome Light Requirements

See TS 46.5, Table #6, Interior Dome Lights---3 position switch

To help eliminate windshield reflection on suburban roads where street lighting is at a low level, provide the following "3 position" switch:

Switched to "All" (On)

All dome lights shall have the ability to be turned "on" at any time (even when bus is not in an operational mode) when the dash toggle switch is moved from the "Off" position to the "All" position. The interior lights are to be programmed by the bus multiplex system to turn "off" after 20 min. when the bus rotary Master Switch is turned "off".

Switched to "Off"

All passenger dome lights turn “off.

Switch to “Normal”

When the front and exit doors are closed, only the street-side dome lights are still “on”.

When the front or exit doors are open, the first row of dome lights (above the driver and the front door) and the curb-side passenger dome lights are turned “on” when in “night run” and “night park”. As soon as the front and rear doors are closed, these lights shall go out.

TS 75.10.2 Dimmer Switch for all Dome Lights

See TS 46.5, Table #6, Dimmer Switch for all Dome Lights.

To help eliminate windshield reflection on suburban roads where street lighting is at a low level, provide a toggle switch or dimmer knob on the dash that can be used to dim the interior dome lights if the operator so desires. This switch or knob shall reduce the lights to 60% brightness. When the front or rear doors open, the dome lights return to full brightness for boarding passengers. When the front and rear doors are both closed, the dome lights return to their previous brightness setting.

Dimming Second Row Lights

~~To help eliminate windshield reflection on suburban roads where street lighting is at a low level, the second light on each side, when “night run” or “night park” is selected, shall be controlled by the switch; off in “off” and on in “normal.” These lights shall be turned on at any time if the switch is in the “on” position.~~

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 design of the interior lighting shall require the approval of the Agency.

DEFAULT-----APPROVED

LED lights.

DEFAULT-----APPROVED

First Light Modules Dim/Extinguish When Front Door is Closed

When the master switch is in the “run” or “night/run” mode, the first light module on each side of the coach shall automatically extinguish or dim when the front door is in the closed position and illuminate when the door is opened.

TS 75.11 Driver’s 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. Provide and “on/off” switch within reach of the operator while sitting in the operator’s seat.

TS 75.12 Seating Areas (Transit Coach)

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 only when the switch is turned to "ALL" interior lights and/or when the front and exit doors are open in the "Rear" position.

LED light fixtures and lenses shall be a maximum 6-foot length.

Provid sufficient low watt LED's that effectively make the dome light look as if a bright white fluorescent bulb is behind the lens. This means the individual LED's and their various color tones cannot be seen through the lens.

A Pretoria LED dome light system has been **APPROVED**.

~~**TS 75.13 Seating Areas (Commuter Coach)**~~

TS 75.14 Vestibules/Doors (Transit Coach)

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/opened.

TS 75.15 Vestibules/Doors (Commuter Coach)

TS 75.16 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~~ master 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.

TS 75.17 Ramp Lighting (Transit Coach)

Exterior and interior ramp lighting shall comply with federal regulations.

~~**TS 75.18 Turntable Lighting (Articulated Coach)**~~

TS 75.19 Farebox Lighting

TS 75.19.1 Transit Coach

DEFAULT (TC) -----APPROVED

Farebox Light (LED)

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.

TS 75.19.2 Commuter Coach

TS 76. Fare Collection

Space and structural provisions shall be made for installation of currently available fare collection devices, which 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 farebox 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 farebox location shall permit accessibility to the vault for easy manual removal or attachment of suction devices. Meters and counters on the farebox shall be readable on a daily basis. The floor under the farebox shall be reinforced as necessary to provide a sturdy mounting platform and to prevent shaking of the farebox. Provide a pedestal, approximately 13” x 13” with a side access door for hooking up wires to the fare box (12” x 12”). The Agency will install a 41” high, GFI Transview 100 on the pedestal. Provide a ground wire and 12 volt power through the Ignition.

Contractor shall provide fare collection installation layout to the Agency for approval.

TS 76.1 Electronic Fare Collection

The bus manufacturer shall install an Agency’s supplied harness for the Electronic Fare Collection (EFC) from the front dash next to the Entrance Door to the Electronics/Radio Compartment which also includes a harness from the rear modesty panel next to the Exit Door to the Electronics/Radio Compartment. The bus manufacture will also install Agency supplied EFC mounting brackets, TBD. The Agency will install Electronic Fare Collection units to the harnesses and mounting brackets.

Transfer mounting, cutting and punching equipment shall be located in a position convenient to the driver.

TS 76.2 Transfer Cutter and Mount

Ship the Transfer Cutter and Mount loose. The Agency will install the Transfer Cutter and Mount.



*A Globe 600090 Transfer Cutter with 2 notchers has been **Approved**.*

DEFAULT-----APPROVED

Agency will install its own farebox.

The Agency requests a Priced alternate for vendor to install a 41" high, GFI Transview 100 farebox

TS 77. Interior Access Panels and Doors (Transit Coach)

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.

ALTERNATIVE-----APPROVED

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.~~

*Access doors shall be secured with 2 locks. The square 5/16 key and the barrel key are **APPROVED**.]*

*SDS box with a key local and two square key locks is **APPROVED**.*

*Rear bulkhead small access panels secured with captive screws is **APPROVED** upon condition that captive*

screws are a tamper resistant type.

*The Electronic/Radio Compartment will have a **standard key lock (TBD)** along with 2 barrel locks.*

TS 77.1 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.

A driveshaft access panel that is manufactured completely out of polyurethane is APPROVED

The number of special fastener tools required for panel and access door fasteners shall be minimized.

PASSENGER ACCOMMODATIONS

TS 78. Passenger Seating

TS 78.1 Arrangements and Seat Style (Transit Coach)

The passenger seating arrangement in the bus shall be such that seating capacity is maximized and in compliance to the following requirements.

NOTE: 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.

DEFAULT-----APPROVED

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~~ battery storage space).

TS 78.2 Rearward Facing Seats (Transit Coach)

DEFAULT-----APPROVED

Rearward facing seats not allowed.

~~TS 78.3 Turntable Seating (Articulated Coach)~~

TS 78.4 Padded Inserts/Cushioned Seats (Transit Coach)

ALTERNATIVE-----APPROVED

Padded Inserts

The passenger seats shall be equipped with vandal-resistant padded inserts throughout the bus (measure to uncompressed surface).

*The American Seating "InSight" with 980 Gray color, cantilevered without shroud has been **APPROVED** for Configuration #1 and Configuration #3. These seats shall be blue padded vinyl. Final color TBD pre-production.*

*The American seating model 2096 with 3 point seatbelts is **APPROVED** for suburban bus configuration. Seats shall have a vinyl upholstery. Final color TBD pre-production.*

TS 78.5 Drain Hole in Seats

DEFAULT-----APPROVED

No requirements for drain hole provision in seat inserts.

ALTERNATIVE

Requirement for Drain Hole Provision in Seat Inserts

Provision, such as a small grommated hole, to allow drainage shall be incorporated into seat insert. (Drain through hole, ¼ in. through hole, bottom seat only, one per seat.)

TS 78.6 Arrangements and Seat Style (Commuter Coach)

TS 78.7 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 a vertical surface immediately in front, shall be a minimum of 26 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.

TS 78.8 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.

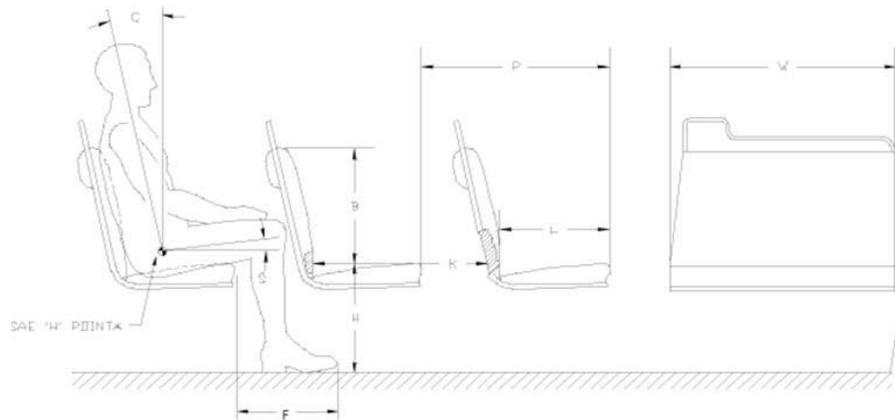
TS 78.9 Aisles (Transit Coach)

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).

TS 78.10 Aisles (Commuter Coach)

TS 78.11 Dimensions (Transit Coach)

FIGURE 6
Seating Dimensions and Standard Configuration



DEFAULT-----APPROVED

Seat dimensions for the various seating arrangements shall have the dimensions as follows (refer to **Figure 6**):

- The width, W, of the two-passenger transverse seat shall be a minimum ~~35~~ **36** 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 deg.
- The seat back slope, C, shall be between 8 and 17 deg.
- Hip to knee room = K.
- The pitch, P, is shown as reference only.

TS 78.12 Structure and Design (Transit Coach)

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 (***pedestal 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 squirmy, 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 7/8 in. in diameter for standees and seat access/egress. ***Provide an Energy Absorbing handhold on the back of transverse seats.*** 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.

~~TS 78.13 Structure and Design (Commuter Coach)~~

TS 78.14 Construction and Materials (Transit Coach)

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, to allow the passenger to deform the seating materials in the impact areas. Complete seat assemblies shall be interchangeable to the extent practicable.

A Rear Settee Hinge is required on the 3 center seats (1-3-1) with gas spring props.

~~TS 78.15 Construction and Materials (Commuter Coach)~~

TS 79. Passenger Assists (Transit Coach)

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 convenient in location, 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 the 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 the front doorway, around the farebox, and at interior steps for bi-level designs shall be powder-coated in a high-contrast yellow color.

ALTERNATIVE-----APPROVED

The forward-most vertical stanchions on either side of the aisle immediately behind the driver's area shall be powder-coated yellow.

TS 79.1 Assists (Transit Coach)

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. 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.

DEFAULT-----APPROVED

Two Forward-Facing Wheelchair Securement Locations

TS 79.2 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. Provide yellow powder coated grab rail passenger assists and stanchions.

TS 79.3 Vestibule (Transit Coach)

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 arms.

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. Provide yellow powder coated grab rail passenger assists and stanchions.

TS 79.4 Rear Doorway(s) (Transit Coach)

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.

Paint the door grab rails, modesty panel grab rails and the vertical stanchions forward and to the rear of the rear exit door with yellow powder coated paint.

NOTE: For an articulated bus, passenger assists will be provided to aid in the transition between the front and rear sections of the bus.

TS 79.5 Overhead (Transit Coach)

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.

ALTERNATIVE-----APPROVED

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

ALTERNATIVE-----APPROVED

Grip straps shall be fabric. Provide 9 Black Nylon straps on each side of the isle for a total of 18 straps. Locations TBD.

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.

TS 79.6 Longitudinal and Transverse Seat Assists (Transit Coach)

Longitudinal and transverse seats shall have vertical assists located between every other designated seating position, except for seats that fold/flip up to accommodate wheelchair securement. Assists shall extend from near the leading edge of the longitudinal seat or the upper corner of the transverse 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.

TS 79.7 Wheel Housing Barriers/Assists (Transit Coach)

Unless passenger seating is provided on top of wheel housings, 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 housings.

TS 80. Passenger Doors

TS 80.1 Transit Coach

Doorways will be provided in the locations and styles as follows. Passenger doors and doorways shall comply with ADA requirements.

TS 80.1.1 Front door

DEFAULT-----APPROVED

Vapor electric-powered door (or submitted deviation) shall be forward of the front wheels and under direct observation of the driver.

TS 80.1.2 Rear Door(s)

ALTERNATIVE-----APPROVED

Curbside doorway centerline located rearward of the point midway between the front door centerline and the rearmost seat back.

ALTERNATIVE-----APPROVED

Electric-powered doors.

TS 80.2 Commuter Coach

TS 80.2.1 Front door

DEFAULT

Forward of the front wheels and under direct observation of the driver

TS 80.3 Materials and Construction

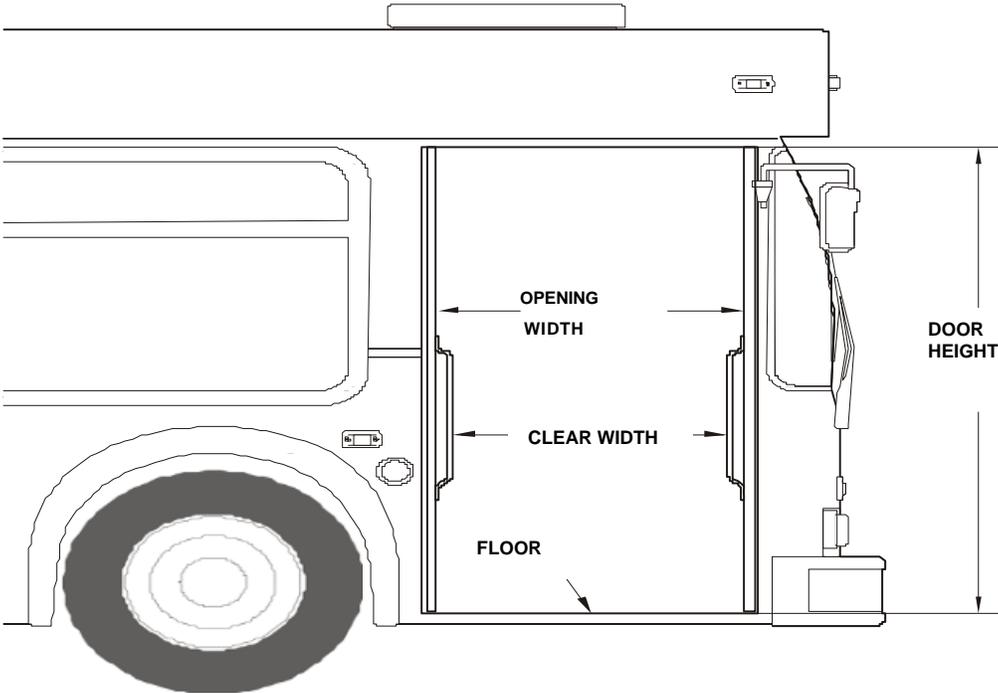
Structure of the doors, their attachments, inside and outside trim panels and any mechanism exposed to the elements shall be corrosion resistant. Door panel construction shall be of corrosion-resistant metal or reinforced non-metallic composite materials. When fully opened, the doors shall provide a 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 (not applicable to single doors). The combined weather seal and window glazing elements of the front door shall not exceed 10 deg of binocular obstruction of the driver's view through the closed door. When open, the

doors shall leave an opening no less than 75 in. in height.

TS 80.4 Dimensions
TS 80.4.1 Transit Coach

FIGURE 7
Transit Bus Minimum Door Opening



DEFAULT **APPROVED DOOR SIZE for TRANSIT BUSES**

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.

If the Agency requires a minimum rear door clear width of 31¾ in. or greater and an outward opening (swing) door is specified, then the maximum outboard excursion of 13 in. may be exceeded.

~~TS 80.4.2 Commuter Coach~~

TS 80.5 Door Glazing

The upper section of both front and rear doors shall be glazed for no less than 45 percent of the respective door opening area of each section. The lower section of the front door shall be glazed for no less than 25 percent of the door opening area of the section.

Door glazing shall be easily replaceable.

DEFAULT-----APPROVED

Zip type glazing rubber.

ALTERNATIVE-----APPROVED

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.

Provide in the rear exit door: two piece door glass, tempered and of the same color as the side passenger windows.

An entrance door glass that is laminated that meets the ANSI requirements and SAE best practices is Approved.

TS 80.6 Door Projection (Transit Coach)

TS 80.6.1 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 14 in. during the opening or closing cycles or when doors are fully opened.

If the rear exit door has a hinge, the hinge shall have a rubber seal to help maintain the conditioned air inside the bus.

TS 80.6.2 Interior

Projection inside the bus shall not cause an obstruction of the rear door mirror or cause a hazard for standees.

TS 80.7 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.

TS 80.8 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.

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.

TS 80.8.1 Rear Door Closing Force (Transit Coach)

The electric style power-close rear doors shall be equipped with a Pneumatic Sensitive Edge and Optical Pressure Switch 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.

~~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.

TS 80.9 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.

The rear door actuator(s) shall be under the complete control of the vehicle operator and shall open and close in response to the position of the driver's door control.

DEFAULT-----APPROVED

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.

~~TS 80.9.1 Actuator (Commuter Coach)~~

TS 80.9.2 Rear Door Interlocks (Transit Coach)

See "Hardware Mounting" for door system interlock requirements.

TS 80.10 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.

TS 80.11 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.

DEFAULT-----APPROVED

The front door shall remain in commanded state position even if power is removed or lost.

ALTERNATIVE

As specified by Agency.

TS 80.12 Door Controller

TS 80.12.1 Transit Coach

DEFAULT

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. Locate the door control lever next to the operator's left hand and next to the forward sliding sash of the operator's side window.

The operator needs to have access from outside the bus through the sliding sash to the door lever.

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.

ALTERNATIVE-----APPROVED

A Vapor control handle with built in kneel and ramp controls with fiberoptic backlighting (or submitted deviation) shall be provided. **The Agency requests this be part of the base bus price.**

~~TS 80.12.2 Commuter Coach~~

TS 80.13 Door Open/Close

ALTERNATIVE-----APPROVED

Operator-Controlled Front and Rear Doors (If Applicable)

Operation of, and power to, the passenger doors shall be completely controlled by the operator.

A switch shall be provided to enable the driver to obtain full control of the rear doors.

DEFAULT-----APPROVED

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 (if applicable), deactivate the door control system, release the interlocks and permit only manual operation of the rear/center doors.

TS 81. 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.

TS 81.1 Loading Systems

There are three options:

- high-floor lift
- low-floor ramp
- platform (boarding bridgeplate) level boarding

TS 81.2 Lift

TS 81.3 Loading System for 30 to 40 ft Low-Floor Bus

An automatically controlled, power-operated ramp system compliant to requirements defined in 49 CFR Part 38, Subpart B, §38.23c 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.

DEFAULT-----APPROVED

Front Door Location of Loading System, Flip-Out Design Ramp with 6:1 Slope

The wheelchair loading system shall be located at the front door, with the ramp being of a simple hinged, flip- out type design being capable of deploying to the ground at a maximum 6:1 slope.

A 'Lift-U' LU18 Ramp has been APPROVED

~~TS 81.4 Loading System for Level Boarding on a 45 to 60 ft Low-Floor BRT~~

TS 81.5 Wheelchair Accommodations

NOTE: Agency will approve acceptable securement system. The final layout and dimensions of all wheelchair accommodation areas shall be shown in drawings transmitted by the Contractor and approved by the UTA Office of Civil or Rights. Contractor shall not commence with the manufacture of buses until such approval is obtained.

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.

ALTERNATIVE

Additional (Beyond Two) Number of Wheelchair Securement Locations **[insert number]** forward-facing location(s), 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.

ALTERNATIVE

Non-Forward Facing

All passenger securement devices must be stowed off the floor and out of the way when not in use.

Provide a securement system using: 3 belts to secure a mobility device, one front belt, 2 rear belts, a timed release mechanism for connecting the 2 rear belts to the mobility device with one hand, and a tensioning lever to tighten the 2 rear belts. Include a tire rub-rail on the floor beneath the flip-up seats or on the underside of the seats, a 14 inch stainless steel horizontal passenger assist (grab rail) on the bottom of the flip-up seats and where space permits, a wall mounted stainless steel horizontal passenger assist.

A Q'Straint O'Pod is Approved.

TS 81.6 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 deg turns of wheelchairs should have a clearance arc dimension no less than 45 in., and in the parking area where 180 deg 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 footrests.

TS 82. Wheelchair Lifts (Commuter Coach)

TS 82.1 Lift

TS 82.2 Lift Door

TS 82.3 Lift Width

TS 82.4 Lighting Requirements Deleted

~~Lighting for the lift areas shall be designed to meet Title 13 and ADA and FMVSS 404 standards. Lighting shall be provided to effectively illuminate the lift area. Light shall be wired through the lift master toggle switch on the driver's dash and shall automatically illuminate when this switch is in the "on" position. The lighting design shall minimize the effect of glare on passengers entering the bus through the wheelchair lift door. During lift operation, the street surface shall be illuminated to a minimum of 6 candlepower a distance of 3 ft beyond the external dimensions of the lift platform once deployed and lowered. Additional lighting shall be provided to ensure illumination of the instruction placard and the manual override pump when it is in use.~~

TS 82.5 Securement System Deleted.

~~The vehicle interior shall permit the securement of two forward-facing wheelchair passengers in which the primary position shall be on the street side of the coach directly across from the lift. Securement areas shall be a minimum 30 × 48 in. as required by the ADA.~~

~~A separate three-point belt securement shall be provided to effectively secure wheelchair passengers. To further secure the passenger during the lift operation, a retractable seat belt strap shall be provided at the ingress/egress area of the lift platform. A minimum 10.5 in. high barrier shall also be provided at the rear of the lift area for additional passenger protection.~~

TS 82.6 Roof Ventilation/Escape Hatches

Two roof ventilators shall be provided and designed to perform as escape hatches. One ventilator/escape hatch shall be located in the roof at the front of the coach, another in the roof at the rear of the coach.

SIGNAGE AND COMMUNICATION

TS 83. Destination Signs

DEFAULT-----APPROVED

A destination sign system shall be furnished on the front and on the right side near the front door.

ALTERNATIVE-----APPROVED

Route sign on the rear of the vehicle. The Agency requests this be a part of the base bus price.

All signs shall be controlled via a single human-machine interface (HMI). In the absence of a single mobile data terminal (MDT), the HMI shall be conveniently located for the bus driver within reach of the seated driver.

Provide a front sign requiring 24 rows x 200 columns with LED's in full color, a curb side destination sign requiring 8 rows x 96 columns with amber LED's and a rear route sign requiring 16 rows x 48 columns with amber LED's. The destination sign shall be capable of being programmed with USB memory sticks.

A Luminator full Color Spectrum 24 Row X 200 Column Titan sign is Approved.

DEFAULT-----APPROVED

The driver shall be able to access the sign while seated.

DEFAULT-----APPROVED

The destination sign compartments shall meet the following minimum requirements:

- Compartments shall be designed to prevent condensation and entry of moisture and dirt.
- Compartments shall be designed to prevent fogging of both compartment window and glazing on the unit itself when the operator's defroster heater is turned on.
- Access shall be provided to allow cleaning of inside compartment window and unit glazing.
- The front window shall have an exterior display area of no less than 8.5 in. high by 56 in. wide.

TS 84. Passenger Information and Advertising (Transit Coach)

TS 84.1 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. Size TBD.

A metal schedule holder shall be installed on the dash, just inside of curbside A-post. This shall be 18" wide, 3/4" thick and 7" high.

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.

TS 84.2 Exterior Displays

Provisions shall be made to integrate advertising into the exterior design of the bus. Advertising media, frames or supporting structures shall not detract from the readability of destination signs and signal lights, and shall not compromise passenger visibility. Advertising provisions shall not cause pedestrian hazards or foul automatic bus washing equipment, and shall not cover or interfere with doors, air passages, vehicle fittings or in any other manner restrict the operation or serviceability of the bus.

Attach only one advertising sign frame on the front bicycle rack.

A 21" x 44" clear anodized aluminum Yarder advertising frame with solid center backing has been **APPROVED**.

A Sportworks 14" x 44" ad frame is Approved.

TS 85. Passenger Stop Request/Exit Signal

TS 85.1 Transit Coach

ALTERNATIVE-----APPROVED

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 (yellow in color), 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, then 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. Provide a drop down pull cord between each window in the low floor section of the bus. 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 a 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."

In addition to the interior "stop requested" message sign. Provide a 2 line amber LED sign for future use as a next stop display. The sign shall come programmed to also display "stop requested" in the meantime.

A Hanover 144 x 19 Amber LED, Flush Mounted sign is APPROVED

ALTERNATIVE-----APPROVED

Additional "Stop Request" Button on Rear Door Stanchion

A heavy-duty "stop request" signal button shall be installed on the modesty panel stanchion immediately

forward of the rear door and clearly identified as “STOP.”

TS 85.2 Commuter Coach

TS 85.3 Signal Chime

TS 85.3.1 Transit Coach

DEFAULT-----APPROVED

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. Opening the front or rear doors will cancel the “Stop Requested” sign message.

Exit signals located in the wheelchair passenger area shall be no higher than 4 ft above the floor. Instructions shall be provided to clearly indicate function and operation of these signals.

Provide an On/Off toggle switch on the operator’s dash to turn “off” the “Stop Request” chime. See TS 46.5, Table #6.

ALTERNATIVE

Passenger signal system shall be arranged with push-button switches accessible by each seated passenger and on stanchions and at rear door locations for standees.

TS 85.3.2 Commuter Coach

DEFAULT

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 ft above the floor. Instructions shall be provided to clearly indicate the function and operation of these signals.

ALTERNATIVE

Agency to specify the stop request system for wheelchair seating area

TS 86. Communications

TS 86.1 Camera Surveillance System

DEFAULT

No surveillance system provisions required.

ALTERNATIVE-----APPROVED

~~Provide all~~ Install all Agency provided wiring and mounting locations for a multi-camera surveillance system for the later provision of and installation of cameras, recorder, microphone, etc. Agency to provide specify the camera system cable to be installed and specify the locations for pre-wiring and the quantity.

ALTERNATIVE

Provide all wiring and mounting locations for a multi-camera surveillance system, including the installation of cameras, recorder, microphone, etc.

TS 86.2 Public Address System

A public address system shall be provided on each bus for facilitating radio system and driver-originated announcements to passengers.

Provide a microphoneless (microphone imbedded in PA amplifier housing) PA system. Provide a clam-shell switch on the floor next to the steering column to activate the microphone. Mounting locations TBD. Provide a fully populated and labeled harness from the amplifier (mounted on the dash) to the Electronics/Radio Compartment located on the street-side front wheel housing well. The Auxiliary Microphone Key and Input Harness is part of the fully populated harness. Provide approximately 36 extra inches of circular coiled harness in the Electronic/Radio Compartment.

*The Clever Devices / SpeakEasy-II has been **APPROVED**.*

TS 86.2.1 Speakers

DEFAULT-----APPROVED

Eight (8) premium interior loudspeakers shall be provided, semi-flush mounted, on alternate sides of the bus passenger compartment, installed with proper phasing. Total impedance seen at the input connecting end shall be 4-8 Ohms. Mounting shall be accomplished with riv-nuts and machine screws.

*A Misco, JC54WP-4A premium interior speaker has been **APPROVED**.*

Exterior PA Speaker

If exterior speaker is exposed to wheelspray from rain/snow off the front wheel, provide an access door with a removable speaker/assembly to allow for easy replacement of Exterior PA speaker.

TS 86.3 Automatic Passenger Counter (APC)

ALTERNATIVE-----APPROVED

An infrared APC system shall be installed. Agency to provide details of APC system, including installation locations and number of buses to be equipped.

Install a vertically mounted (Hella type sensors), APC at the front and rear exit door(s) of each bus. Location TBD. Mount the CPU in the Electronic/Radio Compartment.

The Agency requests this be a part of the base bus price.

*The Urban Transportation Associates, two door installation (Integrated System RS232) has been **Approved**.*

TS 86.4 Radio Handset and Control System

TS 86.4.1 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. The contactor will install the Agency's supplied harness from the Electronic/Radio Compartment to the driver's speaker located on the dash unless there is a better location. Exact location TBD. The Agency will install the speaker once the bus is delivered.

TS 86.4.2 Handset

Contractor will install the Agency's provided handset harness from the Electronic/Radio Compartment to the dash. Exact location TBD. The Agency will install the handset once the bus is delivered. ~~a handset for driver use.~~

TS 86.4.3 Driver Display Unit (DDU) (or MDC)

~~Contractor shall install a driver display unit as close to the driver's instrument panel as possible.~~ The Contractor will install the Agency provide MDC (DDU) harness from the dash to the Electronic/Radio Compartment. Exact location TBD. The Agency will install the MDC once the bus is delivered.

Provide a reinforced mounting pad on the dash to mount these components. Location TBD.

TS 86.4.4 Emergency Alarm

Contractor shall install an Agency supplied emergency alarm wiring harness for the foot operated Emergency Alarm Switch from the Electronic/Radio Compartment down to the floor in front of the operator's seat. Exact location TBD. ~~emergency alarm that is accessible to the driver but hidden from view.~~

TS 87. Event Data Recorders (EDR)

DEFAULT-----APPROVED for the installation of harnesses, see TS 86.1. Cameras and EDR to be installed later by the Agency.

No EDR shall be installed.

ALTERNATIVE

EDRs shall be installed on the bus, one at the front and the other at the rear. These units are to be installed as low as possible. The EDRs shall be able to communicate over the J1939 CAN line and shall each be equipped with three-axis accelerometers. Settings are to be finalized with the Agency during pre-production. EDRs shall broadcast via the J1939 data communication link severe impact events to the vehicle monitoring system and also trigger an event in the camera system. The EDR shall also tag an event from a signal received over the J1939 CAN line from the silent alarm switch signal and the camera event button and in turn broadcast these events to the vehicle monitoring system. The EDR shall also record the following operational data: headlights on or off, turn signals and hazard lights on or off, ignition on or off, low air pressure warning, whether moving in forward or reverse or idling, and whether parking brake is on or off.

TS 88. Approved Equals

Table 8 lists products that have been approved for the bus procurement. The list contains products that are of interest to the Agency and is not intended to be a comprehensive listing of every product required for the manufacture of the subject buses. Product categories not listed are left to the discretion of the Contractor so long as the product complies with the specifications. Product specification information is for reference only and may not reflect the latest or future improvements by manufacturers. Any change, revision or substitution of specified products **requires approval of the agency**. To add to or revise this list, Contractor must submit a written request *and performance specifications/test results* per the Specification by the due date found in the RFP for approved equals.

NOTE: Transit agencies are encouraged to list as many suppliers as possible.

TABLE 8
Approved Equals Products

Product	Manufacturer	Product Specification
TS 9. Oil pan drain valve	Fumoto Engineering	Fumoto #F104, N Series valve
TS 9. HD push button sample valve		Check Fluid #KP18NV
CNG powered engine	Cummins	TS 9. Cummins ISL-G 320 hp, 1000 lbs-ft
CNG powered engine	Cummins	TS 9. Cummins ISB-G, 280 hp, 660 lbs-ft
Diesel powered engine	Cummins	TS 9. Cummins ISL, 330 hp, 1,154 lbs-ft
Diesel powered engine	Cummins	TS 9. Cummins ISB, 280 hp, 660 lbs-ft
Engine block heater	Phillips-Temro	TS 9. Phillips-Temro, 110 volts, 1,000 watts
Electric cooling fans for radiator/CAC	Modine	TS 10. Modine electric fan system
Transmission	Voith	TS 11. Voith, SenseTop programming
Oil cleaner spinner	F.F. Huggins	TS 14. Spinner II 576 HE
Electric drive compartment	Forester Instruments	TS 14. LCD display #7-743-028
Constant torque hose clamps	Oetiker and Breeze Clamps	TS 15. Oetiker and Breeze
Diesel fuel filling components	Emco-Wheaton	TS 18. Posilock 105 Dry Break/Flip Cap
CNG fuel system	Agility	TS 18. Agility CNG System
Shop air couplers	Foster	TS 25. Foster 10-3
Shock Absorbers	Koni	TS 31. Adjustable shock absorbers
Aluminum Bus wheels	Alcoa	TS 32. Cryogenic hardened surfaces and
Flow thru valve stem Caps	Meyers Tire Supply	TS 32. V2B Flow thru Valve Stem Caps, #21534
Valve Stems	Meyers Tire Supply	TS 32. Dill Valve Stems , #VS-554-D
Lug Nut Covers	Alcoa	TS 32. Alcoa Lug Nut Covers, #000185
Electric Steering Assist	TRW	TS 33. Electric steering assistance with

Small diameter steering wheel		TS 33. VIP 16", Soft Touch, 2 spoke steering wheel
Air System Dryer for 100% air compressor duty cycle	SKF	TS 39. Dual Turbo 2000 with double oil and water filtration and heated
Bus AGM Batteries	Odyssey	TS 42. AGM Odyssey 4yr warranty battery, #31-PC2150S-H
UltraCapacitor for bus starting	KBI	TS 42. KBI KAPower #KSM050024
Battery jump start connector	Whitaker	TS 42. Whitaker Jump Start Connector
Electrical Corrosion Preventive Spray	NOCO Chemical in Cleveland	TS 42. Battery Corrosion Preventive Spray, NOCO, NCP-2, Part #A-202
Weatherproof low voltage electrical connectors	Packard Electric	TS 42. Packard Electric Weather Pack Connectors
Sun Shades (Windshield Visors)	Automation Sun Shade	TS 46. Push/Pull scissor action sun shades
Adjustable Throttle and Brake Pedals	Konsberg Pedals	TS 46. Push button adjustable, throttle and brake pedals
2 Garbage cans	Rubbermaid	TS 47. Rubbermaid Garbage Cans, #2952
Operator's Seat	Recaro	TS49. Recaro, Ergo-Metro AM80
Curb-side exterior rear mirrors,	Hadley	TS 49. Part #20-55185V009
Street-side exterior rear mirrors, mirror housing, and arms	Hadley	TS 49. Part #20-55184V192
Rear view camera for backing up	Safety Vision	TS 49. Safety Vision rear view backing camera
Air Conditioning Compressor	Thermo King	TS 54. Thermo King Screw Compressor, #S391

TS 89. Radio Antennas

*The Contractor shall install 2 Agency supplied antennas with attached cables in the roof of the bus just over the Electronic/Radio Compartment. Route the antenna cables into the electronic/radio compartment with the extra cable in a round service loop. Do not tie the service loop into a dog-bone shape. **Exact location and details TBD.***

TS 90. Electronic/Radio Compartment

Provide an Electronic/Radio Compartment on top of the street-side front wheel well . Minimum Size: 44 inches high, 2 feet wide, 2 feet deep, 4 sliding shelves that can be latched tight so they don't rattle. The interior of the Electronics/Radio Compartment shall be painted white and have two electric fans controlled by a thermostat to remove hot air from inside the compartment.

Install a 12 volt and 24 volt power cable sized for a maximum of 40 amps directly from a 40 amp fuse located in the battery box to the Electronic/Radio Compartment. Install a ground cable from a battery ground lug in the battery box to the Electronic/Radio Compartment. Provide an Ignition Sense wire into the Electronic/Radio Compartment. Provide all cables and wires with at least a 30 inch service loop. **Wiring shall be approved by the Agency.**

Four (4) aluminum trays 15.31" wide, 19.50" deep with a variation in height accommodation within the SDS enclosure of 32.5", with a base tray of 13.0" wide, 19.5" deep is Approved.

A single electric fan that is controlled by a thermostat is Approved.

A fuse box that is the main power distribution point for the LVDC power on the bus, located directly rearward of the battery enclosure, protected by a 50 amp breaker that is re-settable is Approved.

The radio power battery ground attached to a stainless steel ground bar in the electric drive compartment (with a cable routes from the batter ground lug to this main power cable batter ground bar) is Approved.

TS 91. Spare Power Train and Accessories

The Power Train Assemblies and Accessories consist of the following for a bus: ~~engine, transmission, transmission oil cooler, turbocharger,~~ electric cooling fan, radiator and shroud, surge tank, ~~fuel filters,~~ catalytic converter, ~~DPF, Selective Reduction Catalyst and piping,~~ engine full flow lube oil filter (spin on type), bypass oil spinner, air compressor, ~~transmission filters,~~ starting motor, engine block heater with its electrical cord, all wiring with attaching clips and brackets, power steering hydraulic pump, ~~air compressor,~~ bus alternator, and differential 3rd member gear set. Provide all air, water, ~~fuel~~ and oil lines for the above components.

All components may be shipped loose. UTA will require a parts/component list with part numbers.

TS 92. Card (Display) Holder

Mount a Card (Display) Holder on the front dash, centered on the curb-side windshield. Provide a card holder, 18" long x 3/4" thick x 7" high with a base 6" wide. Make out of .080" aluminum, powder coated black. A sample Card Holder will be given to the successful proposer.



TS 93. Hubodometer and Guard

Provide an electronically read hubodometer with the capacity of 999,999 miles, mounted on the curb-side rear axle hub. Provide a stout metal guard around the hubodometer, painted with zinc rich primer and aluminum paint.

*The Stemco Data Trac 600-9999 has been **APPROVED**.*

TS 94. Schedule Racks, Driver's Defect Booklet Holder, Registration Card Holder

Provide 3 Schedule Holders mounted to the rear but near the operator and accessible to customers.

Dimensions:

3.88" wide x 5" high x 1.62" deep.

Provide 1 Driver's Defect Booklet Holder mounted behind the operator. Dimensions:

6" wide x 6.13" high x 2.16 " deep.

Provide 1 Registration/Permit Holder mounted above the operator. Dimensions:

9" wide x 6" high x .090" deep with clear plastic cover.

TS 95. Real Time Operating and Maintenance Telematics

Provide an onboard telematics system allowing the agency to monitor the vehicle in real-time.

The system shall include tools to assess vehicle health, driver monitoring information, location, conditions and diagnostics. All hardware, software and subscription charges to be included in the base bus price.

New Flyer Connect TM has been **APPROVED**