American Public Transit Association

TECHNICAL SPECIFICATIONS

Standard

Bus

Procurement

Guidelines

1999

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The Standard Bus Procurement Guidelines - Technical Specifications is the Phase II portion of the Standard Bus Procurement Guidelines (SBPG). This document, the result of a cooperative effort by the American Public Transit Association (APTA), Federal Transit Administration (FTA), and the Transit Industry will provide benefits to the entire industry for years to come.

The Technical Specifications are the culmination of many hours of work by the SBPG Phase II Steering Committee, the consultant team, and APTA. With the dedicated guidance of the co-chairs, the Steering Committee did an outstanding job in preparing a document that will provide substantial and long reaching benefits to the Transit Industry. This effort and the cooperation exhibited by the members of the Steering Committee is to be commended.

The commercial Terms and Conditions, Phase I, and the Technical Specifications, Phase II, are companion documents and are intended to be used together. Plans are being formulated to provide regular reviews and revision of these documents, as required, to keep them current.

Options to the Technical Specifications are currently being developed for low-floor buses, alternative fuels (CNG), operator workstation, and electronic interfaces.

STANDARD BUS PROCUREMENT GUIDELINES
TECHNICAL SPECIFICATIONS
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5 TECHNICAL SPECIFICATIONS

5.1 GENERAL

5.1.1 SCOPE

Part 5: Technical Specifications define requirements for a heavy duty transit bus which, by the selection of specifically identified alternative configurations, may be used for both suburban express service and general service on urban arterial streets. It is intended for the widest possible spectrum of passengers, including children, adults, the elderly, and persons with disabilities.

5.1.2 DEFINITIONS

The following are definitions of special terms used in Part 5.

(1) dBA. Decibels with reference to 0.0002 microbar as measured on the "A" scale.

(2) 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.

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

(4) Free Floor Space. Floor area available to standees, excluding stepwells, area under seats, area occupied by feet of seated passengers, and the vestibule area forward of the standee line. Floor area of 1.5 square feet shall be allocated for the feet of each seated passenger.

(5) 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 operator.

(6) Seated Load. One hundred fifty pounds for every designed passenger seating position and for the operator.

(7) Gross Load. One hundred fifty pounds for every designed passenger seating position, for the operator, and for each 1.5 square feet of free floor space.

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

(9) GVW (Gross Vehicle Weight). Curb weight plus gross load.

(10) 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.

(11) Heavy Heavy-Duty Diesel Engine (HHDD). Heavy heavy-duty diesel engines have sleeved cylinder liners, are designed for multiple rebuilds, and a rated horsepower that generally exceeds 250.

(12) Operator'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.

(13) Fireproof. Materials that will not burn or melt at temperatures less than 2,000E F.

(14) 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.

(15) Human Dimensions. The human dimensions used in Part 5: Technical Specifications are defined in Humanscale 1/2/3, N. Diffrient, A. R. Tilley, J. C. Bardagjy, MIT Press.

(16) HIC (Head Injury Criteria). The following equation presents the definition of head injury criteria:

$$\left[\frac{1}{t_1 - t_2}\int_{t_2}^{t_1}(a)dt\right]^{2.5}(t_2 - t_1)$$

where:

a = the resultant acceleration at the center of gravity of the head form expressed as a multiple of g, the acceleration of gravity.

t_1 and t_2 = any two points in time during the impact.

(17) Baseline Configuration Bus. The bus described by Part 5: Technical Specifications if no alternatives are selected. Signing, colors, the destination sign reading list and other information must be provided by the Procuring Agency in attachments to Part 5: Technical Specifications.

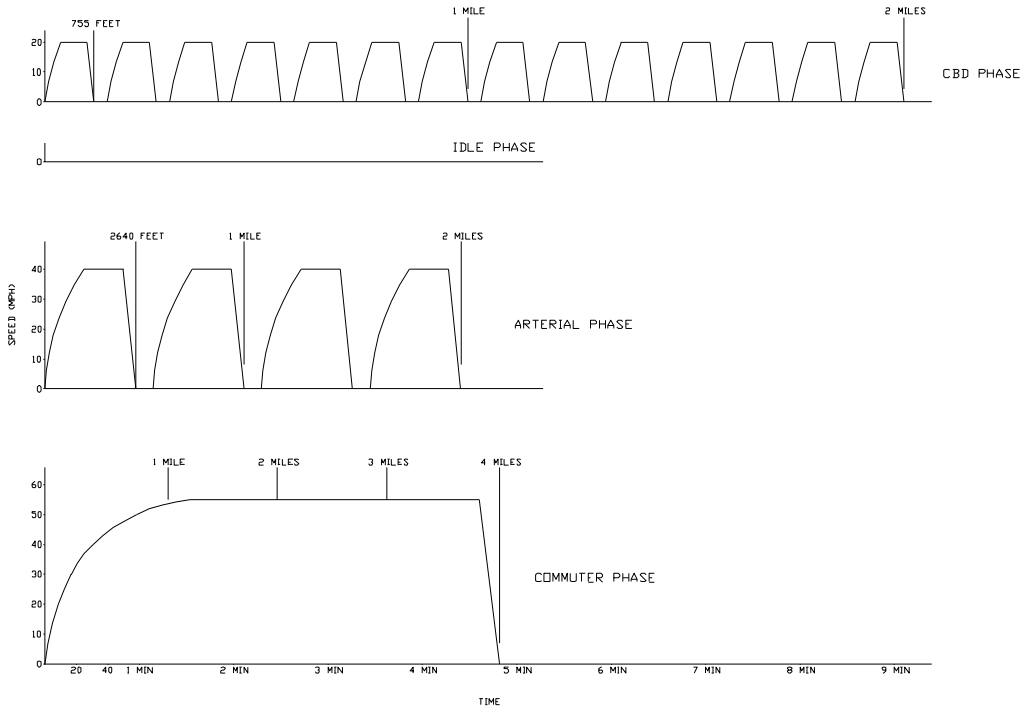
(18) Alternative. An alternative specification condition to the standard configuration bus. The Procuring Agency may define alternatives to the standard configuration

to satisfy local operating requirements. Alternatives for the standard configuration will be clearly identified.

(19) Design Operating Profile. The operating profile for design purposes shall consist of simulated transit type service. The duty cycle is described in the figure "Transit Coach Duty Cycle." The duty cycle consists of three phases to be repeated in sequence: a central business district (CBD) phase of 2 miles with 7 stops per mile and a top speed of 20 mph, an arterial route phase of 2 miles with 2 stops per mile and a top speed of 40 mph, and a commuter phase of 4 miles with 1 stop and a maximum speed of 55 mph and a 5 minute idle phase.

Phase	Stops/ Mile	Top Speed (mph)	Miles	Accel. Dist. (ft.)	Accel. Time (s)	Cruise Dist. (ft.)	Cruise Time (s)	Decel. Rate (fpsps)	Decel. Dist. (ft.)	Decel. Time (s)	Dwell Time (s)	Cycle Time (min-s)	Total Stops
CBD	7	20	2	155	10	540	18.5	6.78	60	4.5	7	9-20	14
Idle	-	-	-	-	-	-	-	-	-	-	-	5-0	-
Arterial	2	40	2	1035	29	1350	22.5	6.78	255	9	7	4-30	4
CBD	7	20	2	155	10	510	18.5	6.78	60	4.5	7	9-20	14
Arterial	2	40	2	1035	35	1350	22.5	6.78	255	9	7	4-30	4
CBD	7	20	2	155	10	510	18.5	6.78	60	4.5	7	9-20	14
Commuter	1 stop for phase	Max. or 55	4	5500	90	2 miles + 4580 ft.	188	6.78	480	12	20	5-10	1
Total			14									47-10	51

Average Speed - 17.8 mph



Transit Coach Duty Cycle

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

16 percent of the stops at 3 ft/sec/sec
50 percent of the stops at 6 ft/sec/sec
26 percent of the stops at 9 ft/sec/sec
8 percent of the stops at 12 ft/sec/sec

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

(20) Class of Failures. Classes of failures are described below.

a. Class 1: Physical Safety. A failure that could lead directly to passenger or operator injury or represents a severe crash situation.

b. Class 2: Road Call. A failure resulting in an en route interruption of revenue service. Service is discontinued until the bus is replaced or repaired at the point of failure.

c. Class 3: Bus Change. A failure that requires removal of the bus from service during its assignments. The bus is operable to a rendezvous point with a replacement bus.

d. Class 4: Bad Order. A failure that does not require removal of the bus from service during its assignments but does degrade bus operation. The failure shall be reported by operating personnel.

(21) Maintenance Personnel Skill Levels. Defined below are maintenance personnel skill levels used in Part 5: Technical Specifications.

a. 5M: Specialist Mechanic or Class A Mechanic Leader
b. 4M: Journeyman or Class A Mechanic
c. 3M: Service Mechanic or Class B Servicer
d. 2M: Mechanic Helper or Bus Servicer
e. 1M: Cleaner, Fueler, Oiler, Hostler, or Shifter

In attachments to Part 5: Technical Specifications, the Procuring Agency may relate the skill levels and ratings of mechanics in its operation to the above definitions.

(22) Standards. Standards referenced in Part 5: Technical Specifications are the latest revisions unless otherwise stated.

(23) 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 inches in width and 48 inches in length measured two inches above the ground, and does not weigh more than 600 pounds when occupied.

(24) Structure. The structure shall be defined as the basic body, including load bearing external panels, structural components, axle mounting provisions and suspension beams and attachment points.

5.1.3 ABBREVIATIONS

The following is a list of abbreviations used in Part 5: Technical Specifications.

(1)	ADA	Americans with Disabilities Act
(2)	ANSI	American National Standards Institute
(3)	ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
(4)	ASTM	American Society for Testing and Materials
(5)	EPA	Environmental Protection Agency
(6)	FTA	Federal Transit Administration
(7)	FMCSR	Federal Motor Carrier Safety Regulations
(8)	FMVSS	Federal Motor Vehicle Safety Standards
(9)	ISO	International Organization for Standardization
(10)	JIC	Joint Industrial Council
(11)	NHTSA	National Highway Traffic Safety Administration
(12)	OSHA	Occupational Safety and Health Administration
(13)	SAE	Society of Automotive Engineers
(14)	SPI	Society of the Plastics Industry
(15)	UL	Underwriters Laboratories

(16) USDOT United States Department of Transportation

5.1.4 LEGAL REQUIREMENTS

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

The bus shall meet all applicable FMVSS and shall accommodate all applicable FMCSR regulations in effect at the date of manufacture.

In the event of any conflict between the requirements of this Specification and any applicable legal requirement, the legal requirement shall prevail.

5.1.5 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. Components used in the vehicle shall be of heavy duty design and proven in transit service.

5.1.5.1 DIMENSIONS

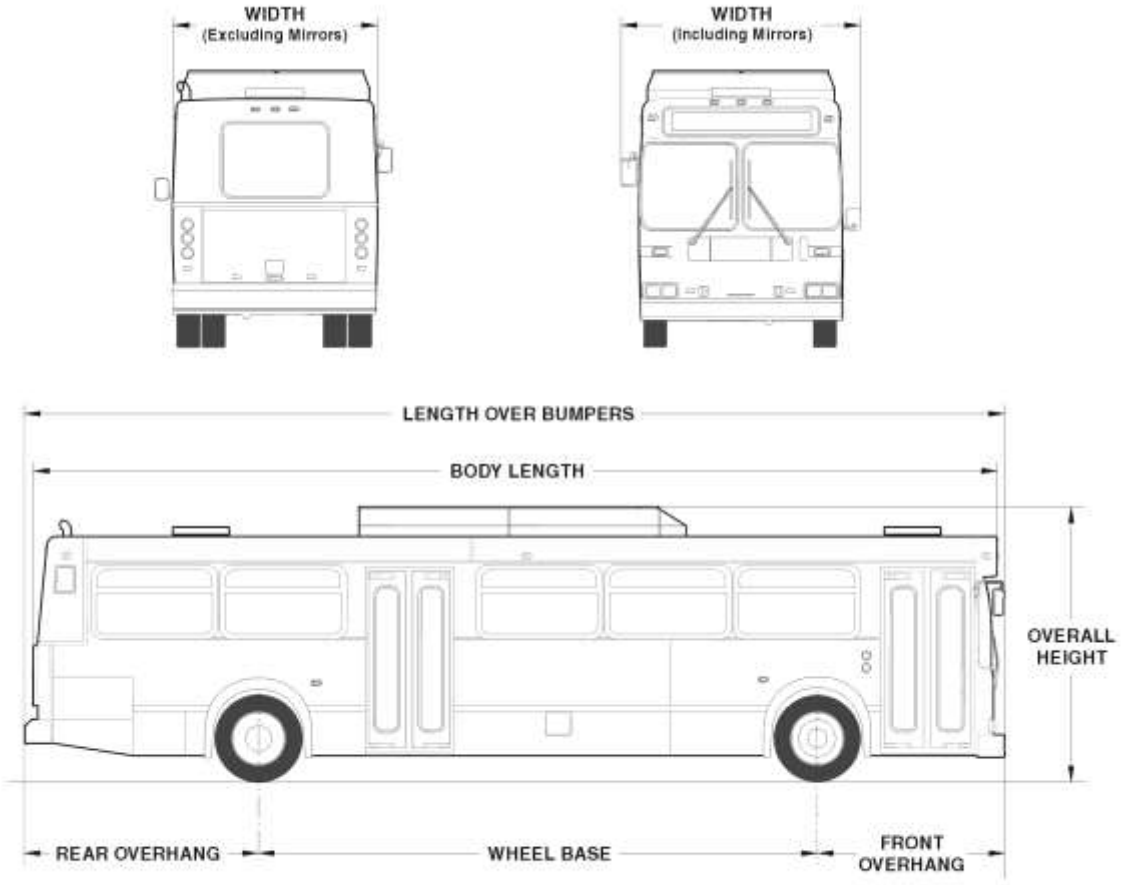
5.1.5.1.1 Physical Size

With the exceptions of exterior mirrors, marker and signal lights, bumpers, fender skirts, washers, wipers and rubrail, the bus shall have the following overall dimensions as shown in the figure "Transit Coach Exterior Dimensions" at static conditions and design height.

Baseline: Use for 40-ft length bus.	*Alternative: Use for 35-ft length bus. Also see Sections 5.1.5.2, 5.1.5.3, 5.4.5.1.1 and 5.4.7.*
(1) Body Length: 40 feet ± 3 inches	(1) Body Length: 35 feet ± 3 inches

Baseline: Use for 102-inch width bus.	*Alternative: Use for 96-inch width bus. Also see Sections 5.1.5.2, 5.4.5.1.1 and 5.4.7.*
(2) Body Width: 102 inches (+0, -1 inch)	(2)Body Width: 96 inches (+0, -1 inch)

(3) Maximum Overall Height: 128 inches, includes all rigid roof mounted items such as A/C, exhaust, etc.



TRANSIT COACH EXTERIOR DIMENSIONS

5.1.5.1.2 Underbody Clearance

The bus shall maintain the minimum clearance dimensions as shown in the figure "Transit Coach Minimum Road Clearance" and defined in SAE Standard J689, regardless of load up to the gross vehicle weight rating.

Ramp Clearances. Approach angle shall be no less than 8.5 degrees. Breakover angle shall be no less than 10 degrees. Departure angle shall be no less than 9 degrees.

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

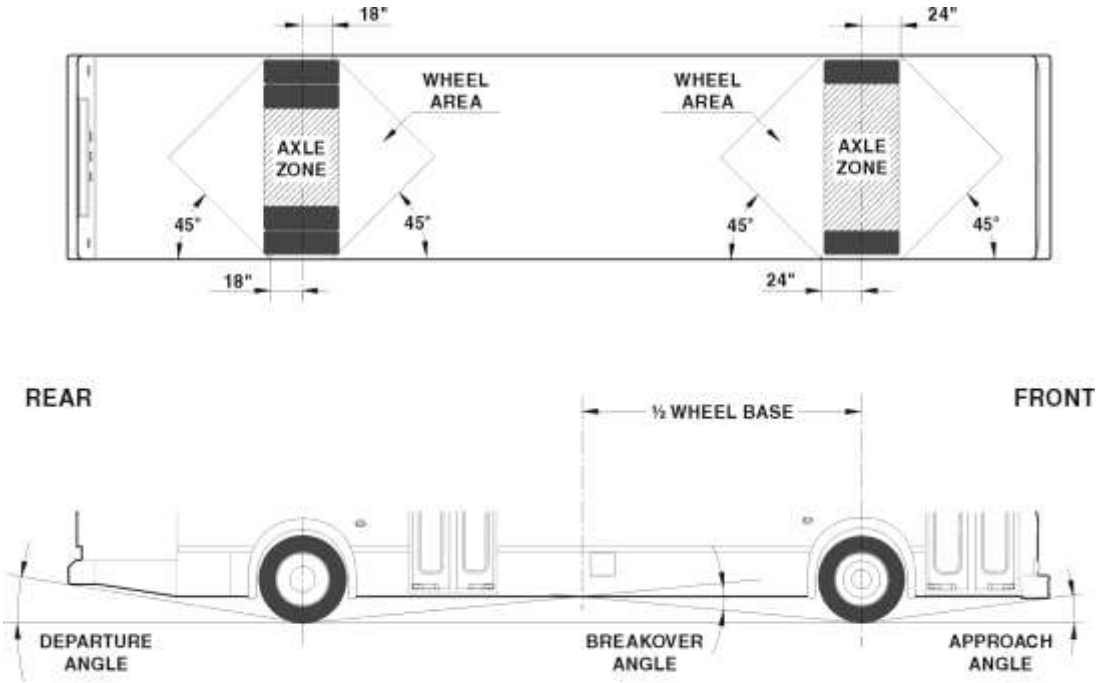
The departure angle is the angle measured between a line tangent to the rear tire static loaded radius arc and the initial point of structural interference rearward of the rear tire to the ground.

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

Ground Clearance. ground clearance shall be no less than 10 inches, except within the axle zone and wheel area.

Axle Clearance. Axle zone clearance, which is the projected area between tires and wheels on the same axial centerline, shall be no less than 5½ inches.

Wheel Area Clearance. Wheel area clearance, shall be no less than 8 inches for parts fixed to the bus body and 6-1/2 inches for parts that move vertically with the axles.



TRANSIT COACH MINIMUM ROAD CLEARANCE

5.1.5.1.3 Floor Height

Height of the floor above the street shall be no more than 35 inches measured at the centerline of the front doorway and 38½ inches measured at the centerline of the rear doorway. The floor may be inclined only along the longitudinal axis of the bus, and the incline shall be less than 1-1/2 degrees of the horizontal except locally at the doors where 1 ½ ^{B} taper toward the door is allowed. All floor measurements shall be with the bus at the design height and on a level surface.

5.1.5.1.4 Step Dimensions

A maximum of three steps shall be required for passenger ingress and egress. The steps in each doorway shall be in a fixed location relative to the floor of the bus. At the front door, the first step up from street level shall not exceed 15 inches with the bus at the design height, and all step riser heights to bus floor level shall be the same height within ∀ 0.25 inches and shall be no more than 10 inches. At the rear door, the interior steps down from floor level shall not exceed 11 3/8 inches, and the final step to street level shall not exceed 16 inches with the bus at the design height.

5.1.5.1.5 Interior Headroom

Headroom above the aisle and at the centerline of the aisle seats shall be no less than 78 inches in the forward half of the bus tapering to no less than 74 inches forward of the rear settee. At the centerline of the window seats, headroom shall be no lower than the required top of the side window. Headroom at the back of the rear bench seat may be reduced to a minimum of 56 inches, but it shall increase to the ceiling height of no less than 74 inches 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/her head, padding shall be provided on the overhead paneling.

5.1.5.2 WEIGHT

Curb weight of the bus, as defined in Section 5.1.2 of these Specifications, shall not exceed *(Procuring Agency to insert weight considering specific configuration including bus width, seating style and configuration, and glazing material)* pounds.

5.1.5.3 CAPACITY

Baseline: Use for 40-ft length bus with baseline seats and baseline seating arrangement. Also see Section 5.4.5 Rated capacity of the bus shall be no less than 43 seated passengers, not including the operator, with the standard seating arrangement.	*Alternative: Use for alternative configurations as noted. Also see Section 5.4.5* Rated capacity of the bus shall be no less than *(Procuring Agency to insert number of Seated Passengers for specified seating arrangement*) seated passengers, not including the operator, with the specified seating arrangement.

5.1.5.4 SERVICE LIFE AND MAINTENANCE

5.1.5.4.1 Service Life

The bus shall be designed to operate in transit service for at least 12 years or 500,000 miles. It shall be capable of operating at least 40,000 miles per year including the twelfth year.

5.1.5.4.2 Maintenance and Inspection

Scheduled maintenance or inspection tasks as specified by the Contractor shall require a skill level of 3M or less. Scheduled maintenance tasks shall be related and shall be grouped in maximum mileage intervals. Based upon the Design Operating Profile defined in Section 5.1.2, routine scheduled maintenance actions, such as filter replacement and adjustments, shall not be required at intervals of less than 6,000 miles, except for engine oil/filter change intervals for severe duty shown below, or as indicated from a regular oil analysis program and routine daily service performed during the fueling operations. Higher levels of scheduled maintenance tasks shall occur at even multiples of mileage for lower level tasks.

SEVERE DUTY OIL/FILTER CHANGE INTERVAL

Average Vehicle Speed MPH	Oil/Filter Change Interval Miles
10 and higher	6000
8 – 10	5000
6 – 8	4000
4 – 6	3000
2 - 4	1500

5.1.5.4.3 Accessibility

All systems or components subject to periodic maintenance or that are subject to periodic failures shall be readily accessible for service and inspection. To the extent practicable, removal or physical movement of components unrelated to the specific maintenance and/or repair tasks involved shall be unnecessary.

As a goal, relative accessibility of components, measured in time required to gain access, shall be inversely proportional to frequency of maintenance and repair of the components. Specific maintainability requirements are defined in other sections of Part 5: Technical Specifications.

5.1.5.4.4 Interchangeability

Components with identical functions shall be interchangeable to the extent practicable. These components shall include passenger window hardware, interior trim, lamps, lamp lenses, and seat assemblies. Components with nonidentical 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.

5.1.5.5 OPERATING ENVIRONMENT

The bus shall achieve normal operation in ambient temperature ranges of -10 degrees to 115E F, at relative humidity between 5 percent and 100 percent, and at altitudes up to 7,500 feet above sea level. Degradation of performance due to atmospheric conditions shall be minimized at temperatures below -10E F, above 115E F, or at altitudes above 7,500 feet.

Special equipment or procedures may be employed to start the bus after being exposed for more than 4 hours to temperatures less than 30E F without the engine in operation. Speed, gradability, and acceleration performance requirements shall be met at, or corrected to, 85E F, 29.00 inches Hg, dry air. The interior climate control system shall perform in accordance with Section 5.4.8 of Part 5: Technical Specifications.

5.1.5.6 NOISE

5.1.5.6.1 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 83 dBA and the operator shall not experience a noise level of more than 75 dBA under the following test conditions. The bus shall be empty except for test personnel, not to exceed 4 persons, and the test equipment. All openings shall be closed and all accessories shall be operating during the test. The bus shall accelerate at full throttle from a standstill to 35 mph on level commercial asphalt or concrete pavement in an area free of large reflecting surfaces within 50 feet of the bus path. During the test, the ambient noise level in the test area shall be at least 10 dBA lower than the bus under test. Instrumentation and other general requirements shall conform to SAE Standard J366. If the noise contains an audible discrete frequency as defined in Section 5.1.2, a penalty of 5 dBA shall be added to the sound level measured.

5.1.5.6.2 Exterior Noise

Airborne noise generated by the bus and measured from either side shall not exceed 83 dBA under full power acceleration when operated at or below 35 mph at curb weight and just prior to transmission upshift. 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 as defined in Section 5.1.2, a penalty of 5 dBA shall be added to the sound level measured. All noise readings shall be taken 50 feet from, and perpendicular to, the centerline of the bus with all accessories operating. Instrumentation, test sites, and other general requirements shall be in accordance with SAE Standard J366. The pull away test shall begin with the front bumper even with the microphone. The curb idle test shall be conducted with the rear bumper even with the microphone.

In addition, the Contractor shall comply with the exterior noise requirements defined in local laws and ordinances identified by the Procuring Agency.

5.1.5.7 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, firewalls, and facilitation of passenger evacuation.

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 FTA Docket 90, dated October 20, 1993.

Fire detection systems as required in Section 5.5.9 shall be provided.

See Section 5.4.1.6 for Fire Walls

The requirements for passenger evacuation provisions related to doors, windows, and escape hatches are defined in Section 5.4 of Part 5: Technical Specifications.

5.1.5.8 ELDERLY AND DISABLED PASSENGERS

The contractor shall comply with all applicable Federal requirements defined in the Americans with Disabilities Act, 49 CFR Part 38, and all state and local regulations regarding mobility-impaired persons. Local regulations are defined as those below the state level.

5.2 PROPULSION SYSTEM

5.2.1 VEHICLE PERFORMANCE

5.2.1.1 POWER REQUIREMENTS

Propulsion system and drive train shall provide power to enable the bus to meet the defined acceleration, top speed, and gradability requirements, and operate all propulsion-driven accessories. Power requirements are based on heavy heavy-duty diesel (HHDD) engines certified for use in all 50 states using actual road test results or computerized vehicle performance data.

5.2.1.2 TOP SPEED

The bus shall be capable of a top speed of *(Procuring Agency to insert number, understanding that top speed requirements may affect other performance characteristics)* mph (for emergency and passing maneuvers) on a straight, level road at GVWR with all accessories operating.

5.2.1.3 GRADABILITY

Gradability requirements shall be met on grades with a dry commercial asphalt or concrete pavement at GVWR with all accessories operating. The power plant shall enable the bus to maintain a speed of 40 mph on a 2-1/2 percent grade and 7 mph on a 16 percent grade.

5.2.1.4 ACCELERATION

The acceleration shall meet the requirements below and shall be sufficiently gradual and smooth to prevent throwing standing passengers off-balance. Acceleration measurement shall commence when the accelerator is depressed - (Idle Start.)

MAXIMUM IDLE START ACCELERATION TIMES ON A LEVEL SURFACE

(Vehicle weight = GVWR, 50-State Power Plant)

SPEED (MPH)	TIME (SEC)
10	5.0
20	10.8
30	20.0
40	31.0

5.2.1.5 OPERATING RANGE

The operating range of the coach run on the design operating profile shall be at least 350 miles with full fuel capacity.

5.2.2 DRIVETRAIN

5.2.2.1 POWER PLANT

5.2.2.1.1 Engine

The HHDD engine shall be designed to operate for not less than 300,000 miles without major failure or significant deterioration. Components of the fuel injector and/or control system shall be designed to operate for not less than 150,000 miles without replacement or major service. Mileage intervals are based on the design operating profile defined in Section 5.1.2.

The engine shall meet all requirements of Part 5: Technical Specifications when operating on Nos. 1 or 2 diesel fuel, as certified by the engine manufacturer and specified by the Procuring Agency. Durability of the engine and its components shall not be seriously reduced and the requirement of Section 5.2.2.5.1 shall be met by operation on either of the commercially available diesel fuels.

The engine shall be equipped with an electronically controlled management system, compatible with multiplex wiring systems and either 12- or 24-volt electrical systems. The engine control system shall be capable of receiving electronic inputs from the engine and other vehicle systems. Communication between these electronic systems shall be made using the SAE J1939 Recommended Practice communication link. The engine's electronic management system shall monitor operating conditions and provide instantaneous adjustments to optimize both engine and bus performance. The system shall have the capability of being programmed, allowing the Procuring Agency to optimize engine performance. Initial performance settings shall only be

changed with authorization from the bus and engine manufacturers to keep engine warranties valid.

The engine shall have on-board diagnostic capabilities, able to monitor vital functions, store out-of-parameter conditions in memory, and communicate faults and vital conditions to service personnel. Diagnostic reader device connector ports, suitably protected against dirt and moisture, shall be provided in operator's area and inside engine compartment. The on-board diagnostic system shall inform the operator via visual and/or audible alarms when out-of-parameter conditions exist for vital engine functions. Conditions that require an operator alarm are identified in Section 5.4.6.1.6.

The engine starter 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 30E 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 Procuring Agency. The requirements for specific cold weather starting aids are included in attachments to Part 5: Technical Specifications.

Baseline: Standard requirements for a fast idle device. The engine shall be equipped with an operator-controlled fast idle device. The fast idle control shall be a two-way toggle mounted on the dash or side console and shall activate only with the transmission in neutral and the parking brake applied. This device may be used to help meet the requirements of bus cool down in Section 5.4.8.	*Alternative: Automatically activated fast idle.* The fast idle device shall be activated and regulated automatically by the engine control system.

Baseline: No requirement for an auxiliary heater.	*Alternative: Auxiliary heater.* An auxiliary heater fired by diesel fuel shall be provided to supplement the heat supplied by the engine and shall have an output necessary to meet the performance criteria specified in 5.4.8.1. The heater shall be equipped with safety devices to prevent the following: overfueling, overheating due to loss of coolant or water pump failure, and operation during conditions of low battery voltage. The auxiliary heater shall be equipped with a self-priming fuel pump.

<table>
<tr><td rowspan="2">Baseline: No requirement for an automatic engine protection feature.</td><td colspan="2">Alternative: Automatic engine protection.

The engine control system shall protect the engine against progressive damage. The system shall monitor conditions critical for safe operation and automatically derate power and/or speed as needed. The on-board diagnostic system, as described in Section 5.4.6.1.6, shall trigger a visual and audible alarm to the operator when the engine control unit detects a malfunction and the engine protection system is activated.</td></tr>
<tr><td>Baseline: No requirement for an automatic engine protection override feature</td><td>Alternative: Automatic engine protection override.
A control shall be available to the operator, allowing him/her to override the engine protection system if additional engine power is required to move the bus in emergency conditions.</td></tr>
</table>

<table>
<tr><td rowspan="2">Baseline: No requirement for an automatic engine shutdown feature.</td><td colspan="2">Alternative: Automatic Engine Shutdown.

The engine control system shall shutdown the engine automatically when parameters established for critical functions are exceeded. The on-board diagnostic system, as described in Section 5.4.6.1.6, shall trigger a visual and audible alarm to the operator when the engine control unit detects a malfunction and the engine shutdown system is activated. Automatic shutdown shall only occur when parameters established for the functions below are exceeded:
Coolant Level
Coolant Temperature
Oil Pressure
Oil Temperature</td></tr>
<tr><td>Baseline: No requirement for an automatic engine shutdown override feature.</td><td>Alternative: Automatic engine shutdown override.
A control shall be available to the operator, to allow override of the engine shutdown system if engine power is required to move the bus in emergency conditions. If both override alternatives are selected (i.e., Automatic Engine Protection and Automatic Engine Override), a single override control may be used.</td></tr>
</table>

5.2.2.1.2 Cooling Systems

The cooling systems shall be of sufficient size to maintain all engine and transmission fluids and engine intake air at safe, continuous operating temperatures during the most severe operations possible and in accordance with engine and transmission manufacturers' cooling system requirements. The cooling system fan/fans control should sense the temperatures of the operating fluids and the intake air and if either is above safe operating conditions the cooling fan should be engaged. The cooling system in new condition shall have an ambient capacity of at least 110EF with water as coolant and sea level operation.

5.2.2.1.2.1 Engine Cooling

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

A sight glass to determine satisfactory engine coolant level shall be provided and shall be accessible by opening one of the engine compartment's access doors. A spring-loaded, push button type valve to safely release pressure or vacuum in the cooling system shall be provided with both it and the water filler no more than 60 inches above the ground and both shall be accessible through the same access door.

The radiator, and charge air cooler if integrated, shall be of durable corrosion-resistant construction with bolted-on removable tanks. The radiator shall be designed so a 2M mechanic can gain access to a substantial portion of the side facing the engine for the purpose of cleaning the radiator in five minutes or less.

Radiators with a fin density greater than 12 fins per inch, and louvered/slit designs, are more susceptible to clogging and deteriorating cooling performance over time and shall not be used - 10 fins/inch or less preferred.

Radiator piping shall meet the requirements of Section 5.2.2.2.4. 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.

Baseline: Standard requirement for coolant	*Alternative: Delete the requirement for*

filtration. The engine cooling system shall be equipped with a properly sized water filter with a spin-on element filter.	*coolant filtration.* The water filter and its plumbing shall not be provided.

Baseline: Standard requirements for cooling fan operation. The cooling fan shall be temperature controlled, allowing the engine to reach operating temperature quickly. The temperature-controlled fan shall not be driven when the coolant temperature falls below the minimum level recommended by the engine manufacturer.	*Alternative: Fixed fan operation.* The cooling fan shall operate continuously with the engine.

5.2.2.1.2.2 Charge Air Cooling

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

5.2.2.1.2.3 Transmission Cooling

The transmission shall be cooled by a separate heat exchanger sized to maintain operating fluid within the transmission manufacturer's recommended parameters of flow, pressure and temperature. The transmission cooling system shall be matched to retarder and engine cooling systems to ensure that all operating fluids remain within recommended temperature limits established by each component manufacturer.

5.2.2.1.3 Transmission

The transmission shall be multiple speed, automatic shift with torque converter, retarder and electronic controls. Gross input power, gross input torque and rated input speed shall be compatible with the engine. A 3M mechanic, with optional assistance, shall be able to remove and replace the transmission assembly for service in less than 16 total combined man-hours. The transmission shall be designed to operate for not less than 300,000 miles on the design operating profile without replacement or major service.

The electronic controls shall be compatible with multiplex wiring systems, capable of receiving inputs from the throttle, shift selector, engine, and transmission. Communication between the transmission and other electronically controlled vehicle systems shall be made using the SAE J1939 Recommended Practice communication link. Electronic controls shall be compatible with either 12 or 24 volt systems, provide consistent shift quality, and compensate for changing conditions such as variations in vehicle weight and engine power. A brake pedal application of 15 to 20 psi shall be required by the operator to engage forward or reverse range from the neutral position.

The electronically controlled transmission shall have on-board diagnostic capabilities, able to monitor functions, store out-of-parameter conditions in memory, and communicate faults and vital conditions to service personnel. A diagnostic reader device connector port, suitably protected against dirt and moisture, shall be provided in the operator's area. The on-board diagnostic system shall trigger a visual alarm to the operator when the electronic control unit detects a malfunction as described in Section 5.4.6.1.6. The transmission shall contain built-in protection software to guard against severe damage.

5.2.2.1.4 Retarder

The transmission shall be equipped with an integral hydraulic retarder designed to extend brake lining service life. The application of the retarder shall cause a smooth blending of both retarder and service brake functions without exceeding jerk requirements as defined in section 5.2.2.1.5. Brake lights shall illuminate when the retarder is activated.

Baseline: Standard requirement for retarder activation. The retarder shall be activated when the brake pedal is depressed.	*Alternative: Throttle activation of the retarder.* The retarder shall be engaged up to a maximum of 50 percent when the throttle is completely released (e.g., zero throttle). The retarder shall only be allowed to exceed 50 percent of its capability when the brake pedal is depressed and the throttle completely released.

Baseline: No requirement for a retarder-activated cooling fan.	*Alternative: Retarder-activated cooling fan.* The thermostatically controlled cooling fan shall be activated when the retarder is engaged and the coolant temperature exceeds the maximum limit established by the engine and transmission manufacturers.

5.2.2.1.5 Jerk

Jerk, the rate of change of acceleration measured at the centerline, floor level of the bus shall be minimized throughout the shifting of each transmission range and retarder application and shall be no greater than 0.3 g/sec. for a duration of a quarter-second or more.

5.2.2.2 MOUNTING

The power plant shall be mounted in a compartment in the rear of the bus. All power plant mounting shall be mechanically isolated to minimize transfer of vibration to the body structure as defined in section 5.4.1.5. Mounts shall control movement of the power plant so as not to affect performance of belt driven accessories or cause strain in piping and wiring connections to the power plant.

5.2.2.2.1 Service

The power plant shall be arranged so that accessibility for all routine maintenance is assured. No special tools, other than dollies and hoists, shall be required to remove the power plant. Two 3M mechanics shall be able to remove and replace the engine and transmission assembly in less than 12 total combined man-hours. The muffler, exhaust system, air cleaner, air compressor, starter, alternator, radiator, all accessories, and any other component requiring service or replacement shall be easily removable and independent of the engine and transmission removal. An engine oil pressure gauge and coolant temperature gauge shall be provided in the engine compartment. These gauges shall be easily read during service and mounted in an area where they shall not be damaged during minor or major repairs.

Engine oil and the radiator filler caps shall be hinged to the filler neck and closed with spring pressure or positive locks. All fluid fill locations shall be properly labeled to help ensure correct fluid is added and all fillers shall be easily accessible with standard funnels, pour spouts, and automatic dispensing equipment. All lubricant sumps shall be fitted with magnetic-type, external, hex head, drain plugs.

The engine and transmission shall be equipped with sufficient heavy-duty fuel and oil filters for efficient operation and to protect the engine and transmission between scheduled filter changes. To the extent practicable, the filters shall be of the spin-on, disposable type or integral with the engine and transmission. All filters shall be easily accessible and the filter bases shall be plumbed to assure correct reinstallation. Fuel and oil lines shall meet the requirements of Section 5.2.2.2.4. The engine shall be equipped with a fuel-priming pump or a check valve fitted in the fuel suction line to aid restarting after fuel filter changes.

5.2.2.2.2 Accessories

Engine-driven accessories shall be unit mounted for quick removal and repair. Accessory drive systems shall operate without unscheduled adjustment for not less than 50,000 miles on the design operating profile. These accessories shall be driven at speeds sufficient to assure

adequate system performance during extended periods of idle operation and low route speed portion of the design operating profile. Belt guards shall be provided as required for safety and shall be sturdy in design and installation and readily removable.

5.2.2.2.3 Hydraulic Systems

Any accessory may be driven hydraulically. The hydraulic system shall demonstrate a mean time between repairs in excess of 50,000 miles. Hydraulic system service tasks shall be minimized and scheduled no more frequently than those of other major coach systems. All elements of the hydraulic system shall be easily accessible for service or unit replacement. Critical points in the hydraulic system shall be fitted with service ports so that portable diagnostic equipment may be connected or sensors for an off-board diagnostic system permanently attached to monitor system operation. All hydraulic lines shall meet the requirements of Section 5.2.2.2.4, and all elements of the hydraulic system shall meet the noise limits defined in Section 5.1.5.6. 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. All elements of the hydraulic system shall meet the accessibility loading requirements of Section 5.4.5.4.2.

Baseline: No requirement for hydraulic system sensors.	*Alternative: Hydraulic system sensors.* Sensors in the hydraulic system, excluding those in the power steering system, shall indicate on the operator's on-board diagnostic panel conditions of low hydraulic fluid level. Specific systems for which low hydraulic fluid level sensors are required are included in attachments to Part 5: Technical Specifications.

5.2.2.2.4 Fluid Lines, Fittings and Clamps, and Charge Air Pipework

All fluid lines and air pipework shall be rigidly supported to prevent chafing damage, fatigue failures, and tension strain.

Radiator piping shall be stainless steel or brass tubing and, if practicable, hoses shall be eliminated. Necessary hoses shall be premium, silicone rubber type that are impervious to all bus fluids. All hoses shall be as short as practicable. All hoses shall be secured with premium, stainless steel clamps that provide a complete 360E 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.

Fuel, oil, and hydraulic lines shall be compatible with the fluid they carry and the high temperature environment in the engine compartment. The lines shall also be compatible with potentially damaging elements of the surrounding environment including heat and salt. Lines shall be capable of withstanding maximum system pressures. Lines within the engine compartment shall be composed of steel tubing where practicable except in locations where flexible lines are specifically required by the Procuring Agency in attachments to Part 5: Technical Specifications.

Flexible fuel and oil lines shall be kept at a minimum and shall be as short as practicable. Flexible lines shall be routed or shielded so that failure of a line shall not allow fuel or oil to spray or drain onto any component operable above the autoignition temperature of the fluid. Flexible lines shall be Teflon hoses with braided stainless steel jackets except in applications where premium hoses are required and shall have standard SAE or JIC brass or steel, factory crimped, swivel, end fittings. Flexible hoses and fluid lines shall not touch one another, or any part of the bus.

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.

The fuel lines forward of the engine bulkhead shall be in conformance to SAE Standard J1149 Type 1 for copper tubing, SAE Standard J526 for welded steel tubing, or SAE Standard J844 for nylon tubing color coded orange.

Charge air pipework and fittings shall be designed to minimize air restrictions and leaks. Pipework shall be as short as possible and the number of bends minimized. The bend radii should be maximized to meet the pressure drop and temperature rise requirements of the engine manufacturers. The cross section of all charge air pipework shall not be less than the cross section of the intake manifold inlet. Any changes in pipework diameter shall be gradual to ensure a smooth passage of air and to minimize restrictions. Pipework shall be routed away from exhaust manifolds and other heat sources, and insulated or shielded as required to meet the pressure drop and temperature rise requirements of the engine, transmission or other component manufacturer.

Charge air pipework shall be seamless, constructed of either stainless steel or anodized aluminum. Pipework between the air filter and turbocharger inlet may be constructed of fiberglass. Connections between all charge air pipework sections shall be sealed with a short section of reinforced hose and stainless steel, constant tension clamps that provide a complete 360E seal.

5.2.2.3 FUEL SYSTEM

5.2.2.3.1 Fuel Tank(s)

The fuel tank(s) shall be securely mounted to the bus to prevent movement during bus maneuvers, but shall be capable of being removed and reinstalled by a 2M mechanic for cleaning or replacement in 2.5 hours or less. The capacity of the fuel tank(s) shall be a minimum of 125 gallons. The fuel tank(s) shall be equipped with an external, hex head, brass drain plug. It shall be at least a 3/8-inch size and shall be located at the lowest point of the tank(s). The fuel tank(s) shall have an inspection plate or easily removable filler neck to permit cleaning and inspection of the tank(s) without removal from the bus. The tank(s) shall be baffled internally to prevent fuel sloshing noise regardless of fill level. The baffles or fuel pickup location shall assure continuous full power operation on a 6 percent upgrade for 15 minutes starting with no

more than 25 gallons of fuel over the unusable amount in the tank(s). The bus shall operate at idle on a 6 percent downgrade for 30 minutes starting with no more than 10 gallons of fuel over the unusable amount in the tank(s).

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

5.2.2.3.2 Fuel Filler

The fuel filler shall be located 7 to 25 feet behind the centerline of the front door on the curbside of the bus. The filler cap shall be retained to prevent loss and shall be recessed into the body so that spilled fuel will not run onto the outside surface of the bus.

The fuel lines forward of the engine bulkhead shall be in conformance to the SAE Standards identified in Section 5.2.2.2.4.

Baseline: Standard requirement for accommodating a fuel filler nozzle. The filler shall accommodate a 1-1/2-inch diameter nozzle and fill rate of not less than 40 gallons per minute of foam-free fuel without spitting back or causing the nozzle to shut off before the tank is full. An audible signal shall indicate when the tank is essentially full.	*Alternative: Dry-break fuel filler.* The fuel filler shall accommodate a nozzle that forms a locked and sealed connection during the refueling process to eliminate spills. Fuel shall not be allowed to flow into the tank unless the nozzle has been properly coupled, locked and sealed to the filler. With the nozzle open, fuel shall enter the tank at a fill rate of not less than 40 gallons per minute of foam-free fuel without causing the nozzle to shut off before the tank is full. The nozzle shall automatically shut off when the tank is essentially full. Once disconnected, fuel shall not be allowed to flow through the nozzle at any time. Any pressure over 3 psi shall be relieved from the fuel tank automatically. An audible signal shall indicate when the tank is essentially full. The dry break system shall be compatible with the Procuring Agency's system defined in the attachment to Part 5, Technical Specifications. The cap shall be retained to prevent loss.

5.2.2.4 FINAL DRIVE

The bus shall be driven by a single heavy-duty axle at the rear with a load rating sufficient for the bus loaded to GVWR. Transfer of gear noise to the bus interior shall be minimized. The rear axle shall be designed to operate for not less than 300,000 miles on the design operating profile without repairs. The lubricant drain plug shall be magnetic type, external hex head. The drive shaft shall be guarded to prevent it striking the floor of the coach or the ground in the event of a tube or universal joint failure.

5.2.2.5 EMISSIONS

5.2.2.5.1 Exhaust Emissions

The engine shall meet all applicable emission standards.

5.2.2.5.2 Exhaust Location

Exhaust gases and waste heat shall be discharged from the roadside rear corner of the roof. The exhaust pipe shall be of sufficient height to prevent exhaust gases and waste heat from discoloring or causing heat deformation to the bus roof. The entire exhaust system shall be adequately shielded to prevent heat damage to any bus component. The exhaust outlet shall be designed to prevent rain, snow or water generated from high-pressure washing systems from entering into the exhaust pipe and causing damage to the catalyst.

5.3 CHASSIS

5.3.1 SUSPENSION

5.3.1.1 GENERAL REQUIREMENTS

Both the front and rear suspensions shall be pneumatic type. The basic suspension system shall last the service life of the bus without major overhaul or replacement. Normal replacement items, such as one suspension bushing, shock absorbers, or air spring shall be replaceable by a 3M mechanic in 30 minutes or less. Adjustment points shall be minimized and shall not be subject to a loss of adjustment in service. Necessary adjustments shall be easily accomplished without removing or disconnecting the components.

5.3.1.2 SPRINGS AND SHOCK ABSORBERS

5.3.1.2.1 TRAVEL

The suspension system shall permit a minimum wheel travel of 3 inches jounce-upward travel of a wheel when the bus hits a bump (higher than street surface), and 3 inches 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 ± 1/2 inch at any point from the height required in Section 5.1.5.1.3.

5.3.1.2.2 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 3 cycles or less after hitting road perturbations. Shock absorbers shall maintain their effectiveness for at least 50,000 miles of the service life of the bus. Each unit shall be replaceable by a 2M mechanic in less than 15 minutes. The shock absorber bushing shall be made of elastomeric material that will last the life of the shock absorber.

5.3.1.2.3 Lubrication

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 without flexible hose end from a pit or with the bus on a hoist. Each element requiring lubrication shall have its own grease fitting with a relief path. Lubricant specified shall be standard for all elements on the bus serviced by standard fittings.

5.3.1.2.4 Kneeling

A kneeling system shall lower the bus a minimum of 3 inches during loading or unloading operations regardless of load up to GVWR, measured at the longitudinal centerline of the front door, by the driver using a three position, spring loaded to center switch. Downward direction will lower the bus. Release of switch at anytime will completely stop lowering motion and hold height of the bus at that position. Upward direction of the switch will allow the system to go to floor height without the driver having to hold the switch up.

Brake and Throttle interlock shall prevent movement when the bus is kneeled. The kneel control shall be disabled when the bus is in motion. The bus shall kneel at a maximum rate of 1.25 inches per second at essentially a constant rate. After kneeling, the bus shall rise within 2 seconds to a height permitting the bus to resume service and shall rise to the correct operating height within 7 seconds regardless of load up to GVWR. During the lowering and raising

operation, the maximum acceleration shall not exceed 0.2g and the jerk shall not exceed 0.3g/sec measured on the front door step tread.

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, minimum 3" diameter, amber lens shall be provided that will blink when kneel feature activated and throughout operation. Kneeling shall not be operational while the wheelchair lift is extended or in operation.

5.3.1.3 WHEELS AND TIRES

5.3.1.3.1 Wheels

Wheels and rims shall be *(procuring agency to specify hub or stud piloted, and whether with aluminum rims)* and shall be integral formed drop center construction and should resist rim flange wear. All wheels shall be interchangeable and shall be removable without a puller. Wheels shall be compatible with tires in size and load-carrying capacity. Front wheels and tires shall be balanced as an assembly per SAE J1986.

5.3.1.3.2 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. *(Procuring agency to describe arrangements for furnishing tires from lessor or supplier.)*

5.3.2 STEERING

5.3.2.1 FRONT AXLE

The front axle shall be non-driving with a load rating sufficient for the bus loaded to GVWR and shall be equipped with grease type front wheel bearings and seals. All friction points on the front axle shall be equipped with replaceable bushings or inserts and lubrication fittings easily accessible from a pit or hoist.

5.3.2.2 STRENGTH

Fatigue life of all steering components shall exceed 1,000,000 miles. No element of the steering system shall sustain a Class I failure when one of the tires hits a curb or strikes a severe road hazard.

5.3.2.3 TURNING RADIUS

Outside body corner turning radius for a standard configuration 40-foot long bus shall not exceed 44 feet. Alternate: 35-foot long bus shall have a turning radius not to exceed 39 feet.

5.3.2.4 TURNING EFFORT

The steering wheel shall be no less than 19 inches in diameter and shall be shaped for firm grip with comfort for long periods of time. The steering wheel shall be removable with a standard or universal puller.

Hydraulically assisted power steering shall be provided. The steering gear shall be an integral type with flexible lines eliminated or the number and length minimized. Steering torque applied by the driver shall not exceed 10 foot-pounds with the front wheels straight ahead to turned 10 degrees. Steering torque may increase to 70 foot-pounds when the wheels are approaching the steering stops. Steering effort shall be measured with the bus at GVWR, stopped with the brakes released and the engine at normal idling speed on clean, dry, level, commercial asphalt pavement and the tires inflated to recommended pressure. Power steering failure shall not result in loss of steering control. With the bus in operation the steering effort shall not exceed 55 pounds 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.

5.3.3 BRAKES

5.3.3.1 SERVICE BRAKE

5.3.3.1.1 Actuation

Service brakes shall be controlled and actuated by a compressed air system. Force to activate the brake pedal control shall be an essentially linear function of the bus deceleration rate and shall not exceed 50 pounds at a point 7 inches above the heel point of the pedal to achieve maximum braking. The heel point is the location of the driver's heel when foot is rested flat on the pedal and the heel is touching the floor or heel pad of the pedal. A microprocessor controlled

Automatic Braking System (ABS) shall be provided. The microprocessor 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 between all wheels in such a ratio as to ensure equal friction material wear rate at all wheel locations

NOTE: Actuation of ABS and/or ATC shall override the operation of the brake retarder.

Baseline: No Automatic Traction Control shall be required.	*Alternative: Microprocessor controlled Automatic Traction Control (ATC) shall be provided.*

5.3.3.1.2 Friction Material

The entire service brake system, including friction material, shall have a minimum overhaul or replacement life of 30,000 miles with a brake retarder on operating profile. Brakes shall be self-adjusting throughout this period.

5.3.3.1.3 Hubs and Drums

Wheel bearing seals shall run on replaceable wear surfaces. Wheel bearing and hub seals shall not leak or weep lubricant for 100,000 miles when running on the design operating profile.

5.3.3.2 PARKING /EMERGENCY BRAKE

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. An emergency brake release shall be provided to release the brakes in the event of automatic emergency brake application. The parking brake valve button will pop out when air pressure drops below requirements of FMVSS 121. 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 operator releases the emergency brake release valve, the brakes shall engage to hold the bus in place.

5.3.4 PNEUMATIC SYSTEM

5.3.4.1 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 as indicted on the instrument panel mounted air gauges, within 15 minutes from the point of governor cut-off.

Provision shall be made to apply shop air to the bus air systems using a standard tire inflation type valve. A quick disconnect fitting specified in attachments to Part 5: Technical Specifications, shall be easily accessible and located in the engine compartment and near the front bumper area for towing. Retained caps shall be installed to protect fitting against dirt and moisture when not in use. Air for the compressor shall be filtered through the main engine air cleaner system. The air system shall be protected by a pressure relief valve set at 150 psi and shall be equipped with check valve and pressure protection valves to assure partial operation in case of line failures.

5.3.4.2 AIR COMPRESSOR

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

5.3.4.3 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 degrees F. Nylon tubing shall be installed in accordance with the following color-coding standards:

Green.	Indicates primary brakes and supply
Red.	Indicates secondary brakes
Brown.	Indicates parking brake
Yellow.	Indicates compressor governor signal
Black.	Indicates accessories

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-foot intervals. Nylon lines may be grouped and shall be supported at 2-foot intervals or less.

The compressor discharge line between power plant and body-mounted equipment shall be flexible convoluted copper or stainless steel line, or may be flexible Teflon hose with a braided stainless steel jacket. Other lines necessary to maintain system reliability shall be flexible Teflon hose with a braided stainless steel jacket. End fittings shall be standard SAE or JIC brass or steel, flanged, 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-foot intervals or less.

Air lines shall be clean before installation and shall be installed to minimize air leaks. All air lines shall be sloped toward a reservoir and routed to prevent water traps. Grommets or insulated clamps shall protect the air lines at all points where they pass through understructure components.

5.3.4.4 AIR RESERVOIRS

All air reservoirs shall meet the requirements of FMVSS Standard 121 and SAE Standard J10 and shall be equipped with clean-out 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 brass drain valves which discharge below floor level with lines routed to eliminate the possibility of water traps and/or freezing in the drain line.

5.3.4.5 AIR SYSTEM DRYER

An air dryer shall prevent accumulation of moisture and oil in the air system. The air dryer system shall include a replaceable desiccant bed, electrically heated drain, and activation device. A 2M/3M mechanic shall replace the desiccant in less than 15 minutes.

5.4 BODY

5.4.1 GENERAL

5.4.1.1 DESIGN

The bus shall have a clean, smooth, simple design, primarily derived from bus performance requirements and passenger service criteria established by Part 5: Technical Specifications. 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. The windows, hatches, and doors shall be able to be sealed. Accumulation on any window of the bus of spray and splash generated by the bus' wheels on a wet road shall be minimized.

5.4.1.2 CRASHWORTHINESS

The bus body and roof structure shall withstand a static load equal to 150 percent of the curb weight evenly distributed on the roof with no more than a 6-inch reduction in any interior dimension. Windows shall remain in place and shall not open under such a load.

The bus shall withstand a 25-mph impact by a 4,000-pound automobile at any point, excluding doorways, along either side of the bus with no more than 3 inches of permanent structural deformation at seated passenger hip height. This impact shall not result in sharp edges or protrusions in the bus interior.

Exterior panels below the rubrail and their supporting structural members shall withstand a static load of 2,000 pounds applied perpendicular to the bus anywhere below the rubrail by a pad no larger than 5 inches square. This load shall not result in deformation that prevents installation of new exterior panels to restore the original appearance of the bus.

5.4.1.3 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; add-on devices and trim, where necessary, shall be minimized and integrated into the basic design.

Baseline: No requirement for anti-graffiti/vandalism surface treatments.	*Alternative: Additional requirements for anti-graffiti/vandalism surface treatments. Also see Sections 5.4.3 and 5.4.4.* The body material surfaces shall be treated to protect them against graffiti and vandalism. The specific requirements for the treatment of exterior surfaces are defined in Section 5.4.3 and interior surfaces in Section 5.4.4.

5.4.1.4 CORROSION

The bus shall resist corrosion from atmospheric conditions and road salts. It shall maintain structural integrity and nearly maintain original appearance throughout its service life, provided it is maintained by the Procuring Agency in accordance with the procedures specified in the Contractor's service manual. With the exception of periodically inspecting the visible coatings applied to prevent corrosion and reapplying these coatings in limited spots, the Contractor shall not require the complete reapplication of corrosion compounds over the life of the bus. All exposed surfaces and the interior surfaces of tubing and other enclosed members shall be corrosion resistant. 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 2-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.

5.4.1.5 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.

5.4.1.6 FIRE WALL

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

5.4.1.7 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 and service doors. Static conditions shall include the vehicle at rest with any one wheel or dual set of wheels on a 6-inch curb or in a 6-inch deep hole.

5.4.2 STRUCTURE

The structure of the bus shall be designed to withstand the transit service conditions typical of an urban duty cycle throughout its service life. The Design Operating Profile defined in Section 5.1.2 shall be considered for this purpose.

The Structure of the bus shall have undergone appropriate structural testing and/or analysis, including Altoona testing, if required, to ensure adequacy of design for the urban transit service.

5.4.2.1 TOWING

Towing devices shall be provided on each end of the bus. Each towing device shall withstand, without permanent deformation, tension loads up to 1.2 times the curb weight of the bus within 20 degrees of the longitudinal axis of the bus. The rear towing device(s) shall not provide a toehold for unauthorized riders. The front towing devices shall allow attachment of a rigid tow bar and shall permit lifting and towing of the bus, at curb weight, by the towing devices and the tow bar until the front wheels are clear of the ground. Towing device should accommodate flat-bedding. The rear tow eyes shall permit lifting and towing of the bus for a short distance, such as in cases of an emergency. The method of attaching the tow bar shall require the specific approval of the Procuring Agency prior to submittal of bids/proposals. Each towing device shall accommodate a crane hook with a 1-inch throat.

5.4.2.2 JACKING

It shall be possible to safely jack up the bus, at curb weight, with a common 10-ton floor jack 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-inch-high run-up block not wider than a single tire. Jacking and changing any one tire shall be completed by a 2M mechanic helper in less than 30 minutes from the time the bus is approached. The bus shall withstand such jacking at any one or any combination of wheel locations without permanent deformation or damage.

5.4.2.3 HOISTING

The bus axles or jacking plates shall accommodate the lifting pads of a 2-post 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.

5.4.2.4 FLOOR

5.4.2.4.1 Design

The floor shall be essentially a continuous flat plane, except at the stepwells and wheel housings. Where the floor meets the walls of the bus, the surface edges shall be blended with a circular section of radius not less than 1 inch, and a molding or cove shall prevent debris accumulation between the floor and wheel housings.

The floor shall be divided into sections that are replaceable by a 3M mechanic in less than 30 minutes for a section up to 5 feet long (excludes the removal/installation of seats and floor covering).

5.4.2.4.2 Strength

The floor deck may be integral with the basic structure or mounted on the structure securely to prevent chafing or horizontal movement. Sheet metal screws shall not be used to retain the floor and all floor fasteners shall be serviceable from one side only. 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 inches from the normal plane. The floor shall withstand the application of 2.5 times gross load weight without permanent detrimental deformation. Floor and step treads, with coverings applied, shall withstand a static load of at least 150 pounds applied through the flat end of a ½ inch diameter rod, with 1/32 inch radius, without permanent visible deformation.

5.4.2.4.3 Construction

The floor shall consist of the subfloor and the floor covering (See 5.4.4.5 Floor Covering). The floor, as assembled, including the sealer, attachments and covering shall be waterproof, nonhygroscopic, and resistant to mold growth. The subfloor shall be resistant to the effects of moisture, including decay (dry rot) and impervious to wood destroying insects such as termites. Plywood, if used, shall be of a thickness calculated to support the design loads, manufactured with exterior glue of Group I Western panels as defined in PS 1-95 (Voluntary Product Standard PS 1-95, Construction and Industrial Plywood) and of a grade that is manufactured with a solid face and back. Plywood shall be installed with the highest-grade veneer up and with all edges sealed. Preservative treated plywood shall utilize a chemical that contains no EPA listed hazardous compounds and have a moisture content at or below fifteen percent. Plywood prior to any preservative treating, 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).

5.4.2.5 STEPWELLS

5.4.2.5.1 Design

Risers shall be continuous, flat, planes across the entire width of the stepwell except for notches which shall not be larger than necessary to accommodate inward opening door panels. Step risers may be inclined, not to exceed 10 degrees, from the vertical with only the lower edge inward.

All step treads shall be designed for uniform depth within standard manufacturing tolerance and which shall be no less than 11 inches and the plane of the step treads shall be parallel to the plane of the floor. Treads shall be covered with 5/16-inch, nonskid, ribbed, composition-rubber material that shall remain effective in all weather conditions. Color of the tread covering shall match the vestibule flooring. The edge of the vestibule floor shall conform to ADA

requirements and shall have a maximum 5/16-inch overhang at the step riser. The edge of the vestibule floor and the end of the step tread shall have a bright, contrasting band, such as white or yellow, no less than 2 inches wide on the full width of the step. The color shall be permanently blended into the tread covering material.

5.4.2.5.2 Structure

The following requirements are not applicable to steps that are reconfigured to provide a wheelchair lift platform. Stepwells shall be corrosion-resistant throughout the service life of the bus. Stepwells shall be replaceable as units if they are constructed of nonmetallic material. The steps shall simultaneously support 300-pound loads evenly distributed over the center half of each step tread without permanent deformation and with elastic deflection of no more than 0.125 inches. Each step tread shall support a load of 500 pounds evenly distributed over the center half of the tread without permanent deformation. The steps shall be sloped ½ to 2 degrees to preclude water accumulation in the stepwells. All intersections of the step tread and riser in the stepwell shall have radii no less than 1/2 inch.

5.4.2.6 WHEEL HOUSING

5.4.2.6.1 Design

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.

Alternate: Tire chain clearance shall be provided on all driven wheels in accordance with SAE Information Report J683.

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.

5.4.2.6.2 Construction

Wheel housings shall be constructed of corrosion-resistant, fire-resistant material. Wheel housings, as installed and trimmed, shall withstand impacts of a 2-inch steel ball with at least 200 foot-pounds of energy without penetration.

5.4.3 EXTERIOR PANELS AND FINISHES

5.4.3.1 PEDESTRIAN SAFETY

Exterior protrusions greater than ½ inch and within 80 inches of the ground shall have a radius no less than the amount of the protrusion. The street-side rearview mirror and required lights and reflectors are exempt from the protrusion requirement. Advertising frames shall protrude no more than 7/8 inch from the body surface and shall have the exposed edges and corners rounded to the extent practicable. Grilles, doors, bumpers and other features on the sides and rear of the bus shall be designed to minimize the ability of unauthorized riders to secure toeholds or handholds.

5.4.3.2 REPAIR AND REPLACEMENT

Exterior panels below the rubrail shall be divided into sections that are repairable or replaceable by a 3M mechanic in less than 30 minutes for a section up to 5 feet long (excludes painting).

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

Baseline: No requirement for anti-graffiti/vandalism surface treatments.	*Alternative: Additional requirements for anti-graffiti/vandalism treatments for exterior surfaces. Also see Sections 5.4.1.3 and 5.4.4.*

5.4.3.3 RAIN GUTTERS

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

Baseline: No rain gutter above passenger side windows.	*Alternative: Rain gutter shall be provided above passenger side windows.*

5.4.3.4 LICENSE PLATE PROVISIONS

Provisions shall be made to mount standard size U.S. 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. License plates shall be mounted at the lower center or lower street side of the bus and shall not allow a toehold or handhold for unauthorized riders.

5.4.3.5 RUBRAILS

Rubrails composed of flexible, resilient material shall be provided to protect both sides of the bus body from damage caused by minor sideswipe accidents with automobiles. Rubrails shall have vertical dimensions of no less than 2 inches or 50 mm with the centerline no higher than 35 inches above the ground between the wheelwells. The rubrails shall be capable of withstanding impacts of 200 foot-pounds of energy from a steel-faced spherical missile no less than 9 inches in diameter and of a 500-pound load applied anywhere along their length by a rigid plate 1 foot in length, wider than the rubrail, and with 1/4-inch end radii with no visible damage to the rubrail, retainer, or supporting structure. The rubrail may be discontinued at doorways and wheelwells. A damaged portion of the rubrail shall be replaceable without requiring removal or replacement of the entire rubrail.

5.4.3.6 FENDER SKIRTS

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

5.4.3.7 SPLASH APRONS

Splash aprons, composed of 1/4-inch-minimum composition or rubberized fabric, shall be installed behind each wheel and shall extend downward to within 4 inches of the road surface at static conditions. Apron widths shall be no less than tire widths, except for the front apron which shall extend across the width of the bus. 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. Other splash aprons shall be installed where necessary to protect bus equipment.

5.4.3.8 SERVICE COMPARTMENTS AND ACCESS DOORS

5.4.3.8.1 Access Doors

Conventional or pantograph hinged doors shall be used for the engine compartment and for all auxiliary equipment compartments including doors for checking the quantity and adding to the engine coolant, engine lubricant and transmission fluid. Access openings shall be sized for easy performance of tasks within the compartment including tool operating space. Access doors shall be of rugged construction and shall maintain mechanical integrity and function under normal operations throughout the service life of the bus. They shall close flush with the body surface. All doors shall be hinged at the top or on the forward edge and shall be prevented from coming loose or opening during transit service or in bus washing operations. Doors with top hinges

shall have safety props stored behind the door or on the doorframe. All access doors shall be retained in the open position by props or counterbalancing with over-center or gas-filled springs 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.

Baseline: Requirement for locks on access doors. Also see Section 5.4.4.8.	*Alternative: Deletion of the requirement for locking access doors. Also see Section 5.4.4.8.*
Access doors larger in area than 100 square inches shall be equipped with locks. The locks shall be standardized as defined by the Procuring Agency in the attachments to Part 5: Technical Specifications so that only one tool is required to open all major access doors on the bus.	Access doors larger in area than 100 square inches shall be equipped with latches. The latches shall be standardized and shall be openable without the use of a key or tool.

The battery compartment or enclosure shall be vented and self-draining. It shall be accessible only from outside the bus. All components within the battery compartment, and the compartment itself, shall be protected from damage or corrosion from the electrolyte and gases emitted by the battery. 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 Master Battery Switch accessibility requirements are defined in Section 5.5.8 of Part 5: Technical Specifications.

5.4.3.8.2 Service Area Lighting

Lights shall be provided in the engine and all other compartments, where service may be required, to generally illuminate the area for night emergency repairs or adjustments. The lights in the engine compartment shall be controlled by a switch located near the rear start controls in the engine compartment. Necessary lights, located in other service compartments, shall be provided with switches on the light fixture or convenient to the light.

5.4.3.9 BUMPERS

5.4.3.9.1 Location

Bumpers shall provide impact protection for the front and rear of the bus with the top of the bumper being 28 ∀ 2 inches 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.

5.4.3.9.2 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' 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 4,000 pounds parallel to the longitudinal centerline of the bus and 5.5-mph impacts into the corners at a 30E 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 in Section 5.1.5.1.1 by no more than 7 inches.

5.4.3.9.3 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 feet 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 inch 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 4,000 pounds, at 4 mph parallel to, or up to a 30E 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 be independent of all power systems 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 in Section 5.1.5.1.1 by no more than 7 inches.

5.4.3.9.4 Bumper Material

Bumper material shall be corrosion-resistant and withstand repeated impacts of the specified loads without sustaining damage. Visible surfaces shall be black or color -coordinated with the bus exterior. These bumper qualities shall be sustained throughout the service life of the bus.

5.4.3.10 FINISH AND COLOR

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 assure 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 to prevent corrosion. The bus shall be completely painted prior to installation of exterior lights, windows, mirrors and other items which 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 dirt and the following other imperfections:

A. Blisters or bubbles appearing in the topcoat film.

B. Chips, scratches, or gouges of the surface finish.

C. Cracks in the paint film.

D. Craters where paint failed to cover due to surface contamination.

E. Overspray.

F. Peeling.

G. Runs or sags from excessive flow and failure to adhere uniformly to the surface.

H. Chemical stains and water spots.

To the degree consistent with industry standards for commercial vehicle finishes, painted surfaces shall have gloss and orange peel shall be minimized. 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. Colors and paint schemes shall be in accordance with the attachments to Part 5: Technical Specifications.

5.4.3.11 NUMBERING AND SIGNING

Monograms, numbers and other special signing specified by the Procuring Agency 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 appliqués. All decals shall be sealed with clear, waterproof sealant around all exposed edges if required by the decal supplier. Signs shall be provided in compliance with the ADA requirements defined in 49 CFR Part, Subpart B, 38.27. The exact wording, size, color, and locations for these signs are found with requirements for other special signs in attachments to Part 5: Technical Specifications.

5.4.3.12 EXTERIOR LIGHTING

All exterior lights shall be designed to prevent entry and accumulation of moisture or dust, and each lamp shall be replaceable in less than 5 minutes by a 2M mechanic helper. Commercially available LED (Light Emitting Diode)-type lamps shall be used wherever possible. Lights mounted on the engine compartment doors shall be protected from the impact shock of door

opening and closing. 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 service doors are opened. Light lenses shall be designed and located to prevent damage when running the vehicle through an automatic bus washer. Lights located on the roof and sides (directionals) of the bus shall have protective shields or be of the flush mount type to protect the lens against minor impacts.

Visible and audible warning 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.

Lamps at the front and rear passenger doorways shall comply with ADA requirements and shall activate only when the doors open and shall illuminate the street surface to a level of no less than 1 foot-candle for a distance of 3 feet outward from the lowest step tread edge. 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. Additional requirements for the illumination of doorways equipped with wheelchair elevators are defined in Section 5.4.5.4.2 of Part 5: Technical Specifications.

Turn-signal lights shall be provided on both sides of the bus. Specific number and mounting requirements are defined in attachments to Part 5: Technical Specifications.

5.4.4 INTERIOR PANELS AND FINISHES

5.4.4.1 GENERAL

Materials shall be selected on the basis of maintenance, durability, appearance, safety, flammability, and tactile qualities. Trim and attachment details shall be kept simple and unobtrusive. Materials shall be strong enough to resist everyday abuse and vandalism; they shall be resistant to scratches and markings. Interior trim shall be secured to avoid resonant vibrations under normal operational conditions.

Interior surfaces more than 10 inches below the lower edge of the side windows or windshield shall be shaped so that objects placed on them fall to the floor when the coach is parked on a level surface. The entire interior shall be cleanable with a hose, using a liquid soap attachment. Water and soap should not normally be sprayed directly on the instrument and switch panels.

Baseline: No requirement for anti-graffiti/vandalism surface treatments.	*Alternative: Additional requirements for anti-graffiti/vandalism treatments for exterior surfaces. Also see Sections 5.4.1.3 and 5.4.4.*

5.4.4.2 FRONT END

The entire front end of the bus shall be sealed to prevent debris accumulation behind the dash and to prevent the operator's feet from kicking or fouling wiring and other equipment. The front end shall be free of protrusions that are hazardous to passengers standing or walking in the front of the bus during rapid decelerations. Paneling across the front of the bus and any trim around the operator's compartment shall be formed metal or plastic material. Formed metal dash panels shall be painted and finished to the quality described in Section 5.4.3.10 or may be carpeted or vinyl covered. Plastic dash panels shall be reinforced, as necessary, vandal-resistant, and replaceable. All colored, painted, and plated parts forward of the operator's barrier shall be finished with a dull matte surface to reduce glare (see Section 5.4.6.1.1). Colors shall match or coordinate with the balance of the bus interior.

5.4.4.3 REAR END

The rear bulkhead and rear interior surfaces shall be material suitable for exterior skin, painted and finished to exterior quality, or paneled with melamine-type material, plastic, or carpeting and trimmed with stainless steel, aluminum, or plastic. Colors, patterns, and materials are defined in attachments to Part 5: Technical Specifications.

5.4.4.4 INTERIOR PANELS

5.4.4.4.1 General

Interior side trim panels and operator's barrier shall be textured stainless steel, anodized aluminum, plastic, melamine-type material, or carpeting. 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. Untrimmed areas shall be painted and finished to the quality described in Section 5.4.3.10. All materials shall comply with the Recommended Fire Safety Practices defined in FTA Docket 90, dated October 20,1993. Colors, patterns, and materials for the interior trim are defined in attachments to Part 5: Technical Specifications.

5.4.4.4.2 Operator Barrier

A barrier or bulkhead between the operator 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.

Baseline: Standard configuration of operator's barrier.	*Alternative: Full-height configuration of operator's barrier.*
The barrier shall extend from below the level of the passenger or operator's seat cushion,	The barrier shall extend from the floor to the ceiling and shall fit the bus side windows, wall,

whichever is lower, to above the level of the seated operator's head and shall fit the bus side windows and wall to prevent passengers from reaching the operator or the operator's personal effects.	and ceiling panels to prevent passengers from reaching the operator or the operator's personal effects.

5.4.4.4.3 Modesty Panels

Sturdy divider panels constructed of durable, unpainted, corrosion-resistant material complementing the interior trim shall be provided at the rear of both stepwells. Modesty panels may be installed at the sides of longitudinal seats when the required armrests are integral. 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 no higher than the lower daylight opening of the side windows and those forward of transverse seats shall extend downward to a level between 1-1/2 and 1 inches above the floor. Panels forward of longitudinal seats shall extend to below the level of the seat cushion. Dividers positioned at the doorways shall provide no less than a 2-1/2-inch clearance between the modesty panel and the opened door to protect passengers from being pinched. The modesty panel and its mounting shall withstand a static force of 250 pounds applied to a four-inch by four-inch area in the center of the panel without permanent visible deformation.

5.4.4.4.4 Rear Bulkhead

The rear bulkhead paneling shall be contoured to fit the ceiling, side walls, and seat backs so that any litter, such as a cigarette package or newspaper, 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, the panel shall be hinged or shall be able to be removed and replaced by a 3M mechanic in 5 minutes. Grilles where access to or adjustment of equipment is required shall be heavy duty and designed to minimize damage.

5.4.4.4.5 Headlining

Ceiling panels shall be textured stainless steel, anodized aluminum, melamine-type material, carpeting, or material suitable for exterior skin painted and finished to exterior quality. Headlining shall be supported to prevent buckling, drumming, or flexing and shall be secured without loose edges. Headlining materials shall be treated or insulated to prevent marks due to condensation where panels are in contact with metal members. Moldings and trim strips, as required to make the edges tamperproof, shall be stainless steel, aluminum, or plastic, colored to complement the ceiling material. Headlining panels covering operational equipment that is mounted above the ceiling shall be on hinges for ease of service but retained to prevent inadvertent opening. Colors, patterns, and materials for the headlining are defined in attachments in Part 5: Technical Specifications.

5.4.4.4.6 Fastening

Interior panels shall be attached so that there are no exposed unfinished or rough edges or rough surfaces. Panels and fasteners shall not be easily removable by passengers. Interior trim fasteners, where required, shall be rivets or cross-recessed head screws.

5.4.4.4.7 Insulation

Any insulation material used between the inner and outer panels shall be sealed or self-sealing to minimize entry and/or retention of moisture. Insulation properties shall be unimpaired during the service life of the bus. Any insulation material used inside the engine compartment shall not absorb or retain oils or water and shall be designed to prevent casual damage that may occur during maintenance operations. All insulation materials shall comply with the Recommended Fire Safety Practices defined in FTA Docket 90, dated October 20,1993.

The combination of inner and outer panels on the sides, roof, wheelwells and ends of the bus, and any material used between these panels shall provide a thermal insulation sufficient to meet the interior temperature requirements of Part 5: Technical Specifications. The bus body shall be thoroughly sealed so that the operator or passengers cannot feel drafts during normal operation s with the passenger doors closed.

5.4.4.5 FLOOR COVERING

The floor covering shall have a non-skid walking surface that remains effective in all weather conditions and complies with all ADA requirements. The floor covering, as well as transitions of flooring material to the main floor and to the stepwell area, shall be smooth and present no tripping hazards. The standee line shall be at least 2 inches wide and shall extend across the bus aisle. This line shall be the same color as the edge of the steps. Color shall be consistent throughout the floor covering. Color and material of the floor covering is defined in attachment to Part 5: Technical Specifications.

The floor in the operator's compartment 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. 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 top step.

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

5.4.4.6 PASSENGER INTERIOR LIGHTING

The interior lighting system shall provide a minimum 15 foot-candle illumination on a 1 square foot plane at an angle of 45 degrees from horizontal, centered 33 inches above the floor and 24 inches in front of the seat back at each seat position. Allowable average light level for the rear bench seats shall be 7 foot-candles. Floor surface in the aisles shall be a minimum of 10 foot-candles, 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 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. Fluorescent tubes shall be a maximum 6-foot length, single-pin, T-12 type. (with exception granted for extinguishing or dimming fixtures as noted below)

Lens material shall be clear polycarbonate. Lens shall be designed to effectively "mask" the fluorescent tube. Lens material shall not drip flaming onto seats if burned. Lens shall be sealed to inhibit incursion of dust and insects yet are easily removable for service. If threaded fasteners are used they must be held captive in the lens. Access panels shall be provided to allow servicing of components located behind light panels. If necessary, the entire light fixture shall be hinged.

Individual ballast shall be provided for each light fixture. Ballast shall have a fireproof housing, minimum operating frequency of 18,000 Hz, reverse polarity protection, integrated circuit breaker/automatic thermal protection, and rebuildable.

When in the RUN and NITE/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 light when the door is opened. this shall be accomplished through use of a ballast specifically designed to accomplish this function without diminished useful fluorescent tube life. It shall be non-potted, have a fireproof housing, have minimum operating frequency of 18,000 Hz, reverse polarity protected, integrated circuit breaker/automatic thermal protection, and be rebuildable.

The light system shall be designed to form part or the entire air conditioning duct.

Baseline: No farebox light.	*Alternative: 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.*

5.4.4.7 FARE COLLECTION

Space, as far forward as practicable, and structural provisions shall be made for installation of currently available fare collection device(s). 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 operator to easily reach the farebox controls and to view the fare register. The fare box shall not restrict access to the operator area, shall not restrict operation of operator controls and shall not restrict operator's field of view per SAE Recommended Practice J1050 (See Section 5.4.7.2.) Location and mounting of fare collection device shall allow use, without restriction, by passengers. Fare box location shall permit accessibility to the vault for easy manual removal or attachment of suction devices. Meters and counters on the fare box shall be readable on a daily basis. A 15-amp minimum, 12 or 24 -volt, DC, protected circuit shall be available to power the fare box. This power service shall include a grounded lead with both wires enclosed in a flexible conduit. The floor under the fare box shall be reinforced, as necessary, to provide a sturdy mounting platform and to prevent shaking of the fare box. The fare box, including make, model, mounting provisions, size, weight, and meter locations, is described in attachments to Part 5: Technical Specifications.

Transfer mounting, cutting, and punching equipment shall be located in a position convenient to the operator. This equipment is defined in attachments to Part 5: Technical Specifications.

5.4.4.8 ACCESS PANELS AND DOORS

Access for maintenance and replacement of equipment shall be provided by panels and doors that appear to be an integral part of the interior. Access doors shall be hinged with gas props or over-center springs, where practical, to hold the doors out of the mechanic's way. Retention of all interior access panels, except on the door actuator compartments, shall be with cross-recessed head screws. Panel fasteners shall be standardized so that only one tool is required to service all special fasteners within the bus.

Baseline: Door actuator access doors with do not require tools or keys to open.	*Alternative: Requirement for locking access doors. Also see Section 5.4.3.8.1*
Access doors for the door actuator compartments shall be secured with hand screws or latches, and shall prevent entry of mechanism lubricant into the bus interior. All fasteners that retain access panels shall be captive in the cover.	Access doors for the door actuator compartments shall be secured with locks, and shall prevent entry of mechanism lubricant into the bus interior. The locks shall be standardized so that only one tool, as required in Section 5.4.3.8.1, is required to open access doors on the bus. All fasteners that retain access panels shall be captive in the cover.

Access openings in the floor shall be sealed to prevent entry of fumes and water into the bus interior. Flooring material shall be flush with the floor and shall be edge-bound with stainless steel, or other material that is acceptable to the Procuring 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.

5.4.5 PASSENGER ACCOMMODATIONS

5.4.5.1 PASSENGER SEATING

5.4.5.1.1 Arrangements

Baseline: Standard configuration with combination of forward facing and longitudinal seating. Passenger seats shall be arranged in a transverse, forward facing configuration, except at the wheel housings where aisle-facing seats may be arranged as appropriate with due regard for passenger access and comfort.	*Alternative: Perimeter seating arrangement.* Passenger seats shall be arranged in longitudinal rows facing the centerline of the bus. One row of transverse, forward facing seats shall be provided at the rear of the bus. Longitudinal seating shall meet the requirements in Section 5.4.5.1.3 except that armrest shall be provided between every other seating position at the same location as vertical passenger assists defined in Section 5.4.5.2.6. Each seat shall have a minimum width of 17 inches, not including the armrest.

Baseline: Use for 40-ft length bus with baseline seats and baseline seating arrangement. Seating capacity with this arrangement shall be no less than 43 passengers. This minimum capacity may be reduced when accommodations for more than two wheelchairs are required in Section 5.4.5.4.	*Alternative: Use for alternative configurations of bus length, seating arrangement and seat type. Also see Section 5.1.5.3.* Seating capacity with this arrangement shall be no less than ____ seated passengers, not including the operator, with the specified seating arrangement. *Note:* *Seating capacity must be coordinated with the configurations listed previously for Section 5.1.5.3.*

Baseline: Use with standard (non-padded) seat configuration. Hip-to-knee room, measured from the front of one seat back horizontally across the highest part of the seat to the seat or panel immediately in front, shall be no less than 26 inches. At all seating positions in paired transverse seats	*Alternative: Use with padded or cushioned seat configuration.* Hip-to-knee room, measured from the front of one seat back cushion horizontally across the highest part of the seat cushion to the seat or panel immediately in front, shall be no less than 26.5 inches. At all seating positions in paired

immediately behind other seating positions hip-to-knee room shall be no less than 26.5 inches.	transverse seats immediately behind other seating positions hip-to-knee room shall be no less than 28 inches.

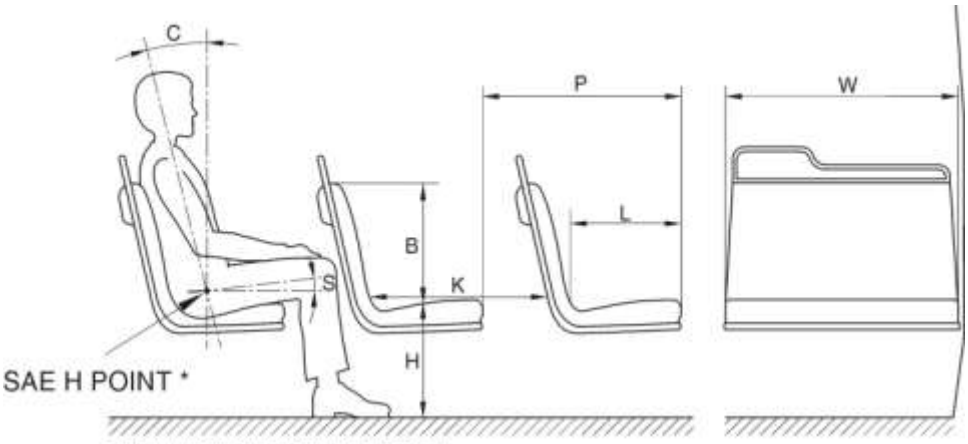
Foot room, measured at the floor forward from a point vertically below the front of the seat cushion, shall be no less than 14 inches. Seats immediately behind the wheel housings may have foot room reduced, provided the wheelhouse is shaped so that it may be used as a footrest.

Each transverse, forward facing seat, except the rear seats, shall be configured to accommodate one or two adult passengers. Thickness of the transverse seat backs shall be minimized to increase passenger knee room and bus capacity. The area between the longitudinal seat backs and the attachment to the bus sidewalls shall be designed to prevent debris accumulation.

Baseline: Use for 102-inch width.	*Alternative: Use with 96-inch width.*
The aisle between the seats shall be no less than 20 inches wide at seated passenger hip height. Seat backs shall be shaped to increase this dimension to no less than 24 inches at standing passenger hip height.	The aisle between the seats shall be no less than 16 inches wide at seated passenger hip height. Seat backs shall be shaped to increase this dimension to no less than 20 inches at standing passenger hip height.

5.4.5.1.2 Dimensions

Seats for the various seating arrangements shall have the dimensions shown in the figure "Seating Dimensions."



FOR ILLUSTRATIVE PURPOSES ONLY

W	WIDTH	35 inches minimum
L	LENGTH	17 ± 1 inches
B	BACK HEIGHT	15 inches minimum
H	SEAT HEIGHT	Transverse seats 17 ± 1 inches Longitudinal seats and rear settee 18 ± 2 inches
S	SEAT CUSHION SLOPE	5 - 11 degrees
C	SEAT BACK SLOPE	9 - 17 degrees
K	HIP TO KNEE ROOM	26 inches minimum
P	PITCH	Reference only

* Reference SAE J826

SEATING DIMENSIONS

5.4.5.1.3 Structure and Design

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

Baseline: Use for cantilevered seats.	*Alternative: Use for Pedestal-mounted seats.*
The 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 inches of the aisle shall be at least 10 inches above the floor.	The structure shall be attached to the sidewall and supported by a pedestal attached to the floor. The lowest part of the seat assembly that is within 12 inches of the aisle, excluding the pedestal, shall be at least 10 inches above the floor.

The underside of the seat and the sidewall shall be configured to prevent debris accumulation and the transition from the seat underside to the bus sidewall to the floor cove radius shall be smooth. 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 1,000 pounds onto the femur of passengers ranging in size from a 5th-percentile female of a 95th-percentile male during a 10g deceleration of the bus. This deceleration shall peak at .05 ∀ .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 inches, measured at the aisle side of the seat frame at height H. Seat back should not deflect more than 14 inches, 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 pounds applied to the top of the seat cushion in each seating position with less than 1/4-inch permanent deformation in the seat or its mountings. The seat assembly shall withstand static horizontal forces of 500 pounds evenly distributed along the top of the seat back with less than 1/4-inch 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-pound 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-inch pendulum and shall strike the seat back 10,000 times each from distances of 6, 8, 10, and 12 inches. Seats at both seating positions shall withstand 4,000 vertical drops of a 40-pound sandbag without visible deterioration. The sandbag shall be dropped 1,000 times each from heights of 6, 8, 10, and 12 inches. Seat cushions shall withstand 100,000 randomly positioned 3-1/2-inch drops of a squirming, 150-pound, smooth-surfaced, buttocks-shape 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 inch in diameter for standees and seat access/egress. The handhold shall not be a safety hazard during severe decelerations. The handhold shall extend above the seat back near the aisle so that standees shall have a convenient vertical assist, no less than 4 inches 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 6 year old child 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 vertical assist is provided in accordance with Section 5.4.5.2. Armrests shall not be included in the design of transverse seats.

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 operator's barrier, or a modesty panel and 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 1-1/2 to 3-1/2 inches of the end of the seat cushion. Armrests shall be located from 7 to 9 inches above the seat cushion surface. The area between the armrest and the seat cushion shall be closed by a barrier or panel and shall be constructed and trimmed to complement the modesty panels. The top and sides of the armrests shall have a minimum width of 2 inches 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 pounds applied anywhere along their length with less than 1/4-inch permanent deformation. Seat back handhold and armrests shall withstand 25,000 impacts in each direction of a horizontal force of 125 pounds with less than 1/4-inch permanent deformation and without visible deterioration.

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

5.4.5.1.4 Construction and Materials

Baseline: Standard seat configuration (non-padded).	*Alternative: Padded seat configuration. Also see Section 5.4.5.1.1.*	*Alternative: Cushioned seat configuration. Also see Section 5.4.5.1.1.*
Seat shall be constructed with materials which comply with the physical test requirements cited in this document. The seats Shall be attached to the frame with tamperproof fasteners. Coloring shall be consistent throughout the seat material, with no visually exposed portion painted. All visually exposed metal of the standard seat structure including mounting brackets and other components shall be aluminum or stainless steel. The seat shall be contoured for individuality, lateral support, and maximum comfort and shall fit the framework to reduce exposed edges. The seat back thickness shall not exceed 1/2 inch in the	Seating and interior trim shall have features to improve passenger comfort. Selected materials shall minimize damage from vandalism and shall reduce cleaning time. The seat shall be contoured for lateral support, individuality, and comfort to each individual passenger. The seat cushion and back shall be padded with a cellular foam product that complies with the physical test requirements cited in this document and is no less than 1/2-inch thick in areas contacted and loaded by passengers in the normal seated position and shall be covered with vinyl and/or fabric material. Seat covering materials shall be selected on the basis of durability, ease of maintenance, and pleasing texture and appearance. The seat back and seat back handhold immediately forward of transverse seats shall be	Seating and interior trim shall have features to maximize passenger comfort. Selected materials shall minimize damage from vandalism and shall reduce cleaning time. The seat cushion shall be supported by springs. The seat cushion and back shall be padded with a cellular foam product that complies with the physical test requirements cited in this document and is no less than 2 inches thick in areas contacted and loaded by passengers in the normal seated position and shall be upholstered with vinyl and/or fabric materials. Springs and cushions shall be shaped for individuality, lateral support, and comfort. The seat back and seat back handhold immediately forward of transverse seats shall be constructed of energy absorbing materials to provide passenger protection and, in a severe crash, allow the passenger to deform the seating materials in the impact areas in accordance with

knee room area. The seat back and seat back handhold immediately forward of transverse seats shall be constructed of energy absorbing materials to provide passenger protection and, in a severe crash, allow the passenger to deform the seating materials in the impact areas in accordance with the Knee Impact and Head Impact Critical requirements of Section 5.4.5.1.3. Complete seat assemblies shall be interchangeable to the extent practicable. Color of the seat material and optional safety padding is defined in attachments to Part 5: Technical Specifications.	constructed of energy absorbing materials to provide passenger protection and, in a sever crash, allow the passenger to deform the seating materials in the impact areas in accordance with the Knee Impact and Head Impact Critical requirements of Section 5.4.5.1.3. 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 1/4-inch. Seats, back cushions, and other pads shall be securely attached and shall be detachable by means of a simple release mechanism employing a special tool so that they are easily removable by the maintenance staff by not by the passengers. To the extent practicable, seat cushions and pads shall be interchangeable throughout the coach bus. Materials shall have high resistance to tearing, flexing, and wetting. Color, fabrics, and patterns for seats and trim are defined in attachments to Part 5: Technical Specifications.	the Knee Impact and Head Impact Critical of Section requirements of Section 5.4.5.1.3. The minimum radius of equipment in any portion of the head or chest impact zone shall be a nominal 1/4-inch. Armrests shall be padded with material that is the same as, or similar to, the seat back padding and handhold. Seats, back cushions, and other pads shall be securely attached and shall be detachable by means of a simple release mechanism employing a special tool so that they are easily removable by the maintenance staff but not by the passengers. To the extent practicable, seat cushions and pads shall be interchangeable throughout the coach bus and the pad coloring shall be consistent throughout the materials. The material shall have high resistance to tearing, flexing, and wetting. Colors, fabrics, and patterns for the seats and all interior trim is defined in attachments to Part 5: Technical Specifications.

5.4.5.2 PASSENGER ASSISTS

5.4.5.2.1 General

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 seat back assist (see Section 5.4.5.1.3) 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. Excluding those mounted on the seats and doors, the assists shall have a cross-sectional diameter between 1-1/4 and 1-1/2 inches or shall provide an equivalent gripping surface with no corner radii less than 1/4 inch. All passenger assists shall permit a full hand grip with no less than 1-1/2 inches of knuckle clearance around the assist. An impact resulting in a 1-foot intrusion shall not produce sharp edges, loose

rails, or other potentially dangerous conditions associated with a lack of structural integrity of the assist. Any joints in the assist structure shall be underneath supporting brackets and securely clamped to prevent passengers from moving or twisting the assists (see Section 5.4.6.1.1 regarding bright surfaces and glare). All areas of the passenger assists that are handled by passengers including functional components used as passenger assists shall be of anodized aluminum or stainless steel. 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 pounds applied over a 12-inch lineal dimension in any direction normal to the assist without permanent visible deformation. Brackets, clamps, screw heads, and other fasteners used on the passenger assists shall be flush with the surface and free of rough edges.

5.4.5.2.2 Front Doorway

Front doors, or the entry area, shall be fitted with assists no less than 3/4-inch in width. Assists shall be as far outward as practicable, but shall be no farther than 6 inches from the outside edge of lower step tread 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 on the front modesty panel.

5.4.5.2.3 Vestibule

The aisle side of the operator's barrier and the modesty panels shall be fitted with vertical passenger assists that are functionally continuous with the overhead assist and that extend to within 36 inches of the floor. These assists shall have sufficient clearance from the barrier to prevent inadvertent wedging of a passenger's arm. A horizontal passenger assist shall be located across the front of the bus and shall prevent passengers from sustaining injuries on the fare collection device or windshield in the event of a sudden deceleration. Without restricting the vestibule space, the assist shall provide support for a boarding passenger from the front door through the fare collection procedure. Passengers shall be able to lean against the assist for security while paying fares. The assist shall be no less than 36 inches above the floor or the average step tread surface. 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 operator's barrier or front modesty panel.

5.4.5.2.4 Rear Doorway

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. Rear doors, or the exit area, shall be fitted with assists no less than 3/4 inch in width and shall provide at least 1-1/2 inches of knuckle clearance between the assists and their mounting. A 5th-percentile female shall be provided assists that are functionally continuous during the entire exiting process, and the assists shall be more than 6 inches from the outside edge of the lower step tread.

5.4.5.2.5 Overhead

Except forward of the standee line and at the rear door, a continuous, full grip, overhead assist shall be provided. This assist shall be convenient to standees anywhere in the bus and shall be located over the center of the aisle seating position of the transverse seats. The assist shall be no less than 70 inches above the floor. Overhead assists shall simultaneously support 150 pounds on any 12-inch length. No more than 5 percent of the full grip feature shall be lost due to assist supports.

5.4.5.2.6 Longitudinal Seats

Longitudinal 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 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 inches apart.

5.4.5.3 PASSENGER DOORS

5.4.5.3.1 General

Two doorways shall be provided in the curb side of the bus for passenger ingress and egress. The front doorway shall be forward of the front wheels and located so that the operator will be able to collect or monitor the collection of fares. The rear doorway centerline shall be rearward of the point midway between the front door centerline and the rearmost seat back. Passenger doors and doorways shall comply with ADA requirements.

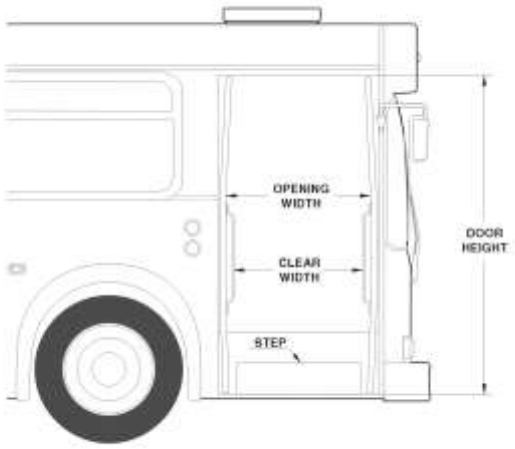
5.4.5.3.2 Materials and Construction

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. The doors, when fully opened, shall provide a firm support and shall not be damaged if used as an assist by passengers during ingress or egress. The front leaves of the passenger doors shall overlap the rear leaves.

5.4.5.3.3 Dimensions

Baseline: Use with standard 30-inch doorway opening width.	*Alternative: Use for doorway opening width greater than 30 inches. Also see Sections 5.1.5.3 and 5.4.5.1.1*

Each door opening clear width shall be no less than 30 inches with the doors fully opened.	The front door opening clear width shall be no less than *(procuring agency insert figure)* inches with the doors fully opened. The rear door opening clear width shall be no less than *(procuring agency insert figure)* inches with the doors fully opened. *Note:* *Either or both doorways may be specified to have a clear width greater than 30 inches. The Procuring Agency should note that increased doorway width may result in a reduction of seating capacity.*



TRANSIT COACH MINIMUM DOOR OPENING

When open, the doors shall leave an opening no less than 84.5 inches in height. Allowable projection into the door opening is shown on the figure "Transit Coach Minimum Door Opening.". Projections shall not form a hazard to passengers. The open doorway clear width, including door-mounted passenger assists or touch bars, shall be no less than 24 inches for each doorway, or equivalent facilitation in accordance with ADA described in 49 CFR Part 38 as determined by the FTA.

The doorway equipped for the ingress and egress of passengers in wheelchairs shall have a clear width no less than 32 inches. These doorways shall have a clear door opening height above a raised lift platform or the highest point of an access ramp of no less than 68 inches.

5.4.5.3.4 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. The edge of a 6-inch-high

curb shall be visible to the seated operator through the closed front door when the bus is more than 12 inches from the curb.

Baseline: Use when standard (glass) side windows are specified in Section 5.4.7.4.2.	*Alternative: Use when polycarbonate or acrylic side windows are specified in Section 5.4.7.4.2.*
The door panel glazing material shall satisfy the requirements of ANSI Z26.1 Test Grouping 2 and the Recommended Practices defined in SAE J673.	The door panel glazing material in the front doorway shall satisfy 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 the same material, thickness and color as the side windows defined in Section 5.4.7.4.2.

5.4.5.3.5 Door Projection

Exterior projection of the doors shall be minimized and shall not exceed 13 inches during the opening or closing cycles or when doors are fully opened. Projection inside the bus shall not exceed 21 inches. The closing edge of each door panel shall have no less than 2 inches of soft weather stripping. The doors, when closed, shall be effectively sealed and the hard surfaces of the doors shall be at least 4 inches apart. Requirements for sensitive door edges are defined in Section 5.4.5.3.7.

5.4.5.3.6 Door Height Above Pavement

It shall be possible to open and close either passenger door when the bus loaded to GVWR is not knelt and parked with the tires touching an 8-inch-high curb on a street sloping toward the curb so that the street side wheels are 5 inches higher than the right side wheels.

5.4.5.3.7 Closing Force

Closing door edge speed shall not exceed 19 inches per second. Power close rear doors shall be equipped with a sensitive edge or other obstruction sensing system such that if an obstruction is struck by a closing door edge, the doors will stop and/or reverse direction prior to imparting a 10-pound force on 1 square inch of that obstruction. Doors closed by return spring or counterweight-type device need not be equipped with an obstruction sensing device but shall be capable of being pushed to the point where the door starts to open with a force not to exceed 20 pounds 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 1-1/2 inch diameter cylinder from between the center edges of a closed and locked door with an outward force not greater than 35 pounds.

5.4.5.3.8 Actuators

Door actuators shall be adjustable so that the door opening and closing speeds can be independently adjustable to satisfy the requirements of Section 5.4.6.1.4. Actuators and the complex door mechanism shall be concealed from passengers but shall be easily accessible for servicing.

5.4.5.3.9 Emergency Operation

In the event of an emergency, it shall be possible to open the doors manually from inside the bus using a force of no more than 25 pounds after actuating an unlocking device at each door. The unlocking devices shall be clearly marked as an emergency-only device and shall require two distinct actions to actuate. The door emergency unlocking device shall be accessible from the stepwell areas. When this emergency device is actuated, the door interlock throttle system shall return the engine to idle and the door interlock brake system shall apply to stop the bus.

Locked doors shall require a force of more than 100 pounds 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, engines, and complex mechanism.

5.4.5.4 ACCESSIBILITY PROVISIONS

5.4.5.4.1 General

The design and construction of the bus shall be in accordance with all requirements defined in 49 CFR, Part 38, Subpart B: ADA Accessibility Specifications for Transportation Vehicles - Buses, Vans and Systems. Space and body structural provisions shall be provided at the front or rear door of the bus to accommodate the wheelchair loading elevator. Specific requirements, including the number of wheelchairs to be accommodated, the tiedown and securement devices, and fold-down seats, are provided in attachments to Part 5: Technical Specifications. Prior to submission of bid, the Contractor shall provide a plan, including layout drawings for entry, maneuvering, parking, and exiting of wheelchair passengers, to show compliance with ADA regulations.

5.4.5.4.2 Loading System

A lift system shall provide ingress and egress quickly, safely, comfortably, and in a forward direction for a passenger in a wheelchair from the street level or curb. When the system is not in use, the steps and passageway shall appear normal, and no portion of the stepwell shall move when the doors open. The controls shall be simple to operate with no complex phasing operations required, and the loading operation shall be under the surveillance and complete control of the operator. If the lift device and controls are at the rear doors, a switch shall be provided in the operator's area to disarm the lift system. The bus shall be prevented from

moving during the loading or unloading cycle by a throttle and brake interlock system. The wheelchair loading system shall not present a hazard, nor inconvenience any passenger. The device shall be inhibited from retracting or folding when a passenger is on the platform. A passenger on the lift platform shall be able to easily obtain support during the entire loading or unloading operation by grasping the passenger assist located on the doors or other assists provided for this purpose. The loading platform shall extend no less than 18 inches outward of the bus, with the transition from the sidewalk to the loading device not exceeding 1/2 inch, and it shall be ramped to the extent practicable. The platform shall be designed to protect the device from damage and persons on the sidewalk from injury during the extension and lowering phases of operation. The loading platform shall be covered with a replaceable or renewable, nonskid material and shall be fitted with devices to prevent the wheelchair from rolling off the ends or sides during loading or unloading. When the elevator platform is rising, no hazard shall be presented to passengers between the platform and the bottom edge of fixed step risers and other parts of the lift mechanism. When fully raised, the transition from the platform to the floor shall be smooth. Deployment or storage of the lift shall require no more than 5 seconds. The time required to perform other phases of the loading or unloading operation shall not exceed 15 seconds. The device shall function without failure or adjustment for 500 cycles or 5,000 miles in all weather conditions on the design operating profile when activated once during the idle phase. A manual override system shall permit unloading a wheelchair and storing the device in the event of a primary power failure. Hydraulic systems incorporated in the lift mechanism shall comply with the requirements defined in Section 5.2.2.2.3 of Part 5: Technical Specifications.

Lights in compliance with ADA requirements shall be provided above the doorway equipped with the wheelchair elevator to floodlight the loading area. The lamps shall illuminate when the elevator is in operation and shall illuminate the street surface to a level of no less than 1 foot-candle for a distance of 3 feet outward from the lowest steptread edge.

5.4.5.4.3 Wheelchair Accommodations

Two forward-facing locations, as close to the wheelchair loading system as practical, shall provide parking space and secure tiedown for a passenger in a wheelchair.

Additional equipment, including passenger restraint seat belts and wheelchair securement devices shall be provided for two wheelchair passengers. Passenger restraint seat belts shall be provided to accommodate passengers in electrically powered wheelchairs. All belt assemblies must stow up and out of the way when not in use.

5.4.5.4.4 Interior Circulation

Maneuvering room inside the bus shall accommodate easy travel for a passenger in a wheelchair from the loading device through the bus to the designated parking area, and back out. No portion of the wheelchair or its occupant shall protrude into the normal aisle of the bus when parked in the designated parking space(s). As a guide, no width dimension should be less than 34 inches. Areas requiring 90-degree turns of wheelchairs should have a clearance arc dimension no less than 45 inches and in the parking area where 180-degree turns are expected,

space should be clear in a full 60-inch-diameter circle. A vertical clearance of 12 inches above the floor surface should be provided on the outside of turning areas for wheelchair footrest provided on the outside of turning areas for wheelchair footrest.

5.4.5.4.5 Passenger Information

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

Requirements for a public information system in accordance with 49 CFR, Part 38.35 shall be provided as required in Section 5.4.9.5 of Part 5: Technical Specifications.

Requirements for a stop-request passenger signal in accordance with 49 CFR, Part 38.37 shall be provided as required in Section 5.4.9.3 of Part 5: Technical Specifications.

Requirements for exterior destination signs in accordance with 49 CFR, Part 38.39 shall be provided as required in Section 5.4.9.1 of Part 5: Technical Specifications.

5.4.6 OPERATOR PROVISIONS

5.4.6.1 OPERATOR'S AREA

5.4.6.1.1 General

The operator's work area shall be designed to minimize glare to the extent possible. Objects within and adjacent to this area shall be matte black or dark gray in color wherever possible to reduce the reflection of light onto the windshield. The use of polished metal and light-colored surfaces within and adjacent to the operator's area shall be avoided. Such objects include dash panels, switches and controls, cowlings, windshield wipers and arms, barriers and modesty panels, fare box and wheelchair lift stanchions, access panels and doors, fasteners, flooring, ventilation and heating ducting, window and door frames, and visors. Interior lighting located ahead of the standee line shall be controlled by the operator. The first section of overhead interior lighting behind the standee line on the curb side of the bus shall not be illuminated when the front passenger door is closed.

5.4.6.1.2 Visors

Adjustable sun visor(s) shall be provided for the side of the windshield and the operator's side window. Visors shall be shaped to minimize light leakage between the visor and windshield 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 overtightening. 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 operator's field of view at angles more than 5 degrees above the horizontal.

Baseline: No sunscreen in the operator's side window.	*Alternative: An adjustable roller type sunscreen shall be provided over the operator's side window.* The sunscreen shall be capable of being lowered to the midpoint of the operator's window. To secure and stabilize the screen, it shall be attached to thin metal rods on each side of the window. Once lowered, the screen shall remain in the lowered position until returned to the stowed position by the operator.

5.4.6.1.3 Operator's Controls

All switches and controls necessary for the operation of the bus shall be conveniently located in the operator's area and shall provide for ease of operation. Switches and controls shall be essentially within the hand reach envelope described in SAE Recommended Practice, J287, Driver Hand Control Reach. Controls shall be located so that boarding passengers may not easily tamper with control settings.

Accelerator and brake pedals shall be designed for ankle motion. Foot surfaces of the pedals shall be faced with wear-resistant, nonskid, replaceable material.

Controls for engine operation shall be closely grouped within the operator's compartment. These controls shall include separate master run switch and start switch or button. The run switch shall be a four-position rotary switch with the following functions:

OFF - All electrical systems off, except power available for the passenger interior lighting, stoplights, turn lights, hazard lights, silent alarm, horn, fare box, fire detection equipment, engine compartment lights, auxiliary heater, if provided and electronic equipment that require continuous energizing. If the bus is not operated for a period of two weeks, the total electric load due to devices that require continuous energizing shall not cause the battery to be discharged below the level necessary to start the engine.

CL/ID - All electrical systems off, except those listed in OFF and power to radio and marker lights.

RUN - All electrical systems and engine on, except the headlights, parking lights and marker lights. Daytime running lights (DRL), if provided, shall be on.

NITE/RUN - All electrical systems and engine on.

The door control, kneel control, windshield wiper/washer controls, and run switch shall be in the most convenient operator locations. They shall be identifiable by shape, touch, and permanent markings. Doors shall be operated by a single control, conveniently located and operable in a horizontal plane by the operator's left hand. The setting of this control shall be easily determined by position and touch. Turn signal controls shall be floor-mounted, foot-controlled, waterproof, heavy-duty, momentary contact switches.

All panel-mounted switches and controls shall be marked with easily read identifiers and shall be replaceable, and the wiring at these controls shall be serviceable from the vestibule or the operator's seat. Switches, controls, and instruments shall be dust- and water-resistant consistent with the bus washing practice described in Section 5.4.4.1.

5.4.6.1.4 Door Control

Operation of, and power to, the passenger doors shall be completely controlled by the operator. 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 of Section 5.4.5.3.7 and the adjustment requirements of Section 5.4.5.3.8. The door control shall be a lever that rotates around a vertical staff. The lever shall be located on the street side of the operator's area approximately 16 inches to the street side of the operator's seat centerline, forward of the seat, and approximately 23 inches above the floor in the operator's area.

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 doors, deactivate the door control system, release the interlocks, and permit only manual operation of the doors.

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 when the rear door control is activated. The braking effort shall be adjustable with hand tools.

5.4.6.1.5 Instrumentation

The speedometer, air pressure gauge(s), and certain indicator lights shall be located on the front cowl immediately ahead of the steering wheel. The steering wheel spokes or rim shall not obstruct the operator's vision of the instruments when the steering wheel is in the straight-ahead position. Illumination of the instruments shall be simultaneous with the marker lamps. Glare or reflection in the windshield, side window, or front door windows from the instruments,

indicators, or other controls shall be minimized. Instruments and indicators shall be easily readable in direct sunlight. Indicator lights immediately in front of the operator are identified in the following table.

Visual Indicator	Audible Alarm	Condition
Back-Up	Backup Alarm	Reverse gear is selected
Hazard	Click	Four-way flashers activated
DRL	None	Daytime Running Lights
High Beam	None	Headlamp high beams activated
Kneel	Kneel Horn	Suspension kneeling system activated
Left Turn Signal	Click	Left turn signal activated
Parking Brake	None	Parking brake is activated
Rear Door	None	Rear passenger door is not closed and locked
Right Turn Signal	Click	Right turn signal activated
Stop Request	Chime	Passenger stop request has been activated
Wheelchair Request	Double Chime	Passenger wheelchair lift request has been activated

The instrument panel shall include a speedometer indicating no more than 80 mph and calibrated in maximum increments of 5 mph. The speedometer shall be a rotating pointer type, with a dial deflection of 220 to 270 degrees and 40 mph near the top of the dial. The speedometer shall be sized and accurate in accordance with SAE Recommended Practice J678.

Baseline: Use for hubodometer.	*Alternative: Use for odometer integrated with the speedometer.*
The bus shall be equipped with a hubodometer mounted at the curb side end of the rear axle. The hubodometer shall have a capacity reading no less than 999,999 miles.	The speedometer shall equipped with an odometer with a capacity reading no less than 999,999 miles.

The instrument panel shall also include air brake reservoir pressure gauge(s) with indicators for primary and secondary air tanks and voltmeter(s) to indicate the operating voltage across the bus batteries. The instrument panel and wiring shall be easily accessible for service from the operator's seat or top of the panel. Wiring shall have sufficient length and be routed to permit service without stretching or chafing the wires.

5.4.6.1.6 On-board Diagnostics

The bus shall be equipped with an on-board diagnostic system that will indicate conditions that require immediate action by the operator to avoid an unsafe condition or prevent further damage to the bus. This diagnostic system shall have visual and audible indicators. The diagnostic indicator lamp panel shall be located in clear sight of the operator but need not be immediately in front of him. The intensity of indicator lamps shall permit easy determination of on/off status in bright sunlight but shall not cause a distraction or visibility problem at night. All indicators shall have a method of momentarily testing the operation of the lamp. The audible alarm shall be temper resistant and shall have an outlet level between 80 and 83 dBA when measured at the location of the operator's ear. Wherever possible, sensors shall be of the closed circuit type, so that failure of the circuit and/or sensor shall activate the malfunction indicator. Malfunction and other indicators listed in the following table shall be supplied on all buses.

Space shall be provided on the panel for future additions of no less than *(5 or number specified by procuring agency)* indicators as the capability of on-board diagnostic systems improves.

Visual Indicator	**Audible Alarm**	**Condition or Malfunction**
ABS	None	ABS System Malfunction
A/C Stop	None	Compressor stopped due to high/low pressure or loss of refrigerant
Check Engine	None	Engine Electronic Control Unit detects a malfunction
Check Transmission	None	Transmission Electronic Control Unit detects a malfunction
Fire	Bell	Over-temperature condition in engine compartment
Generator Stop	None	Loss of generator output
Hot Engine	Buzzer	Excessive engine coolant temperature
Low Air	Buzzer	Insufficient air pressure in either primary or secondary reservoirs
Low Oil	Buzzer	Insufficient engine oil pressure
Low Coolant	Buzzer	Insufficient engine coolant level
Wheelchair Lift	Beeper	Wheelchair lift is not stowed and disabled

5.4.6.2 WINDSHIELD WIPERS

The bus shall be equipped with a variable speed windshield wiper for each half of the windshield, with separate controls for each side. If powered by compressed air, exhaust from the wiper motors shall be muffled or piped under the floor of the bus. No part of the windshield wiper mechanism shall be damaged by manual manipulation of the arms. At 60

mph, no more than 10 percent of the wiped area shall be lost due to windshield wiper lift. Both wipers shall park along the edges of the windshield glass. Windshield wiper motors and mechanisms shall be easily accessible for repairs or service from inside or outside the bus and shall be removable as complete units. The fastener that secures the wiper arm to the drive mechanism shall be corrosion resistant.

5.4.6.3 WINDSHIELD WASHERS

The windshield washer system shall deposit washing fluid on the windshield and, when used with the wipers, shall evenly and completely wet the entire wiped area. If powered by compressed air, all fluid shall be purged from the lines after each use of the washers.

The windshield washer system shall have a minimum 3-gallon reservoir, located for easy refilling and protected from freezing. Reservoir pumps, lines, and fittings shall be corrosion-resistant, and the reservoir itself shall be translucent for easy determination of fluid level.

5.4.6.4 OPERATOR'S LIGHTING

The operator's area shall have a light to provide general illumination and it shall illuminate the half of the steering wheel nearest the operator to a level of 10 to 15 foot-candles. This light shall be controlled by the operator.

5.4.6.5 OPERATOR'S SEAT

5.4.6.5.1 Dimensions

The operator's seat shall be comfortable and adjustable so that persons ranging in size from the 95th-percentile male to the 5th-percentile female may operate the bus. The operator's seat cushion shall have a minimum width of 18 inches, a length of 16 to 18 inches, and rearward slope of 0 to 10 degrees (non-adjustable.) The operator's seat back height, measured from the point of intersection of the uncompressed seat cushion with the seat back to the top of the back, shall be 20 ∀2 inches. The angle formed between the seat back and the seat cushion shall be adjustable in the range of 95 to 110 degrees. Height of the seat shall be adjustable so that the distance between the top of the uncompressed seat cushion and the floor may vary between 17 and 21 inches. The seat shall be adjustable forward and rearward for a minimum travel of 7.5 inches. While seated, the operator shall be able to make all of these adjustments by hand without complexity, excessive effort, or being pinched. Adjustment mechanisms shall hold the adjustments and shall not be subject to inadvertent changes.

5.4.6.5.2 Structure and Materials

The operator's seat shall be contoured to provide maximum comfort for extended period of time. Cushions shall be fully padded with at least 3 inches of a cellular foam product in the seating areas at the bottom and back that complies with the physical test requirements cited in this document. Upholstery shall be ventilated, transportation grade vinyl.

Baseline: Use for standard (air-cushion) seat.	*Alternative: Use for fixed seat.*
The operator's seat shall be cushioned supplementally by an air cylinder or air diaphragm. These devices may also provide the seat height adjustments. Damping shall be provided as required.	

All visually exposed metal on the operator's seat, including the pedestal, shall be unpainted aluminum or stainless steel.

Baseline: Use for standard (may be lap only) seat belt.	*Alternative: Use for three-point (lap and shoulder) seat belt.*
Required Type I seat belts shall be fastened to the seat so that the operator may adjust the seat without resetting the seat belt. Seat belts shall be stored in automatic retractors.	Seat belts shall be provided across the operator's lap and diagonally across the operator's chest. The operator shall be able to use both belts by connecting a single buckle on the right side of the seat cushion. The belts shall be fastened to the seat and/or the bus structure so that the operator may adjust the seat without resetting the seat belt. Seat belts shall be stored in automatic retractors.

The seat and seatbelt assemblies as installed in the bus shall withstand static horizontal forces as required in FMVSS 207 and 210. The seat shall withstand 10,000 impacts of a 40-pound sandbags dropped from a height of 12 inches without visible deterioration. The seat shall be tested in the lowest vertical position and repeated with the seat in the top vertical position.

Two 40-pound sandbags shall be suspended on a 36-inch pendulum and shall strike the seat back 10,000 times each from distances of 6, 8, 10, and 12 inches. Seat cushions shall withstand 100,000 randomly positioned 3-1/2-inch drops of a squirming, 150-pound, smooth-surfaced, buttocks-shape striker with only minimal wear on the seat covering.

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

Color of the operator's seat is defined in the attachments to Part 5: Technical Specifications.

5.4.6.6 MIRRORS

5.4.6.6.1 Exterior Mirrors

<table>
<tr><td colspan="2">Baseline: Use for mirrors on both sides.
The bus shall be equipped with a corrosion-resistant, outside rearview mirror on each side of the bus. Mirrors shall permit the operator to view the highway along both sides of the bus, including the rear wheels. The curb-side rearview mirror shall be mounted so that its lower edge is no less than 80 inches above the street surface.</td><td rowspan="2">Alternative: Use for replacement of curb-side mirror with CCTV camera and monitor.
The bus shall be equipped with a corrosion-resistant, outside rearview mirror on the street side of the bus. A video camera shall be mounted on the curb side of the bus and connected to a monitor visible to the operator. The monitor image shall be not less than 8 inches when measured diagonally. The mirror and video system shall permit the operator to view the highway along both sides of the bus, including the rear wheels. The location of the video camera and monitor shall be approved by the Procuring Agency.</td></tr>
<tr><td>Baseline: standard curb-side mirror (without remote adjustment)</td><td>Alternative: Use for remote adjustment of curb-side mirror.

The operator shall be able to adjust the curb-side mirror remotely while seated in the driving position. The control for remote positioning of the mirror shall be a single switch or device.</td></tr>
</table>

Mirrors shall be firmly attached to the bus to prevent vibration and loss of adjustment, but not so firmly attached that the bus or its structure is damaged when the mirror is struck in an accident. Mirrors shall retract or fold sufficiently to allow bus washing operations.

Baseline: non-heated exterior mirrors.	*Alternative: Use for heated exterior mirrors.* All exterior mirrors shall be electrically heated. The heaters shall be energized whenever the operator's heater and/or defroster is activated.

5.4.6.6.2 Interior Mirrors

Mirrors shall be provided for the operator to observe passengers throughout the bus without leaving his seat and without shoulder movement. With a full standee-load, including standees in the vestibule, he shall be able to observe passengers in the front and rear stepwells,

anywhere in the aisle, and in the rear seats. Inside mirrors shall not be in the line of sight to the right outside mirror.

5.4.7 WINDOWS

5.4.7.1 GENERAL

Baseline: Use with 40-ft length.	*Alternative: Use with 35-ft length.*
A minimum of 11,000 square inches of window area, including door windows, shall be required on each side of the standard configuration bus.	A minimum of 10,000 square inches of window area, including door windows, shall be required on each side of the standard configuration bus.

5.4.7.2 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 15 degrees, measured above the horizontal and excluding any shaded band. The vertically downward view shall permit detection of an object 3-1/2 feet high no more than 2 feet in front of the bus. The horizontal view shall be a minimum of 90 degrees above the line of sight. Any binocular obscuration due to a center divider may be ignored when determining the 90-degree requirement, provided that the divider does not exceed a 3-degree angle in the operator's field of view. Windshield pillars shall not exceed 10 degrees of binocular obscuration. The windshield shall be designed and installed to minimize external glare as well as reflections from inside the bus.

The windshield shall be easily replaceable by removing zip-locks from the windshield retaining moldings. Bonded-in-place windshield shall not be used. The windshield glazing material shall have a 1/4-inch or 6 mm nominal thickness laminated safety glass conforming with the requirements of ANSI Z26.1 Test Grouping 1A and the Recommended Practices defined in SAE J673. The glazing material shall have single density tint. The upper portion of the windshield above the operator's field of view shall have a dark, shaded band with a minimum luminous transmittance of 6 percent when tested in accordance to ASTM D-1003.

5.4.7.3 OPERATOR'S SIDE WINDOW

The operator's side window shall open sufficiently to permit the seated operator to easily adjust the street side outside rearview mirror. This window section shall slide rearward 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 operator's side window glazing material shall have a ¼ inch or 6 mm nominal thickness laminated safety glass conforming with the requirements of ANSI Z26.1 Test Grouping 2 and the Recommended Practices defined in SAE J673.

5.4.7.4 SIDE WINDOWS

5.4.7.4.1 Dimensions

<table>
<tr><td rowspan="2">Baseline: Use for fixed side windows.

All side windows shall be fixed in position, except as necessary to meet the emergency escape requirements.</td><td colspan="4">Alternative: Use for all openable side window configurations.

All side windows, except windows in passenger doors and those smaller than 500 square inches, shall have window panels that are openable by passengers. Openable window panels shall be equipped with latches that secure the window in the fully open and fully closed positions. (The Procuring Agency may, in attachment to Part II: Technical Specifications, define the requirements for stops limiting the window opening travel and, therefore, the window opening area to a finite dimension.)</td></tr>
<tr><td>openable windows with inward-opening transom panels:
Each openable 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</td><td>openable windows with sliding transom panels.
Each openable 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 consist of two horizontally-sliding panels.</td><td>openable windows with a fixed transom panel and sliding lower panels.
Each openable side window shall incorporate an upper transom portion. The transom shall be between 25 and 35 percent of the total window area. The transom portion of the window shall be fixed. The lower portion shall consist of two horizontally-</td><td>openable windows with full-height sliding panels.
Each openable side window shall consist of two full-height horizontally sliding panels.</td></tr>
</table>

	inward.		sliding panels.	

All side windows shall be easily replaceable without disturbing adjacent windows and shall be mounted so that flexing or vibration from engine operation or normal road excitation is not apparent.

The windows shall be designed and constructed to enable a 3M mechanic to remove and replace two windows in less than 10 minutes.

Baseline: No Cyclone Cleaner provision	*Alternative: Provision for Cyclone*: An opening in the rear of the bus shall be provided to accommodate a cyclone cleaner. An openable rear window may be used if the window cannot be accidentally closed during the cleaning operation. Minimum size of this opening is defined in attachment to Part 5: Technical Specifications.

5.4.7.4.2 Materials

Baseline: Use for safety glass glazing panels.	*Alternative: Use for polycarbonate glazing panels. Also see Section 5.1.5.2.*	*Alternative: Use for acrylic glazing panels. Also see Section 5.1.5.2.*
Side windows glazing material shall have a 1/4-inch nominal thickness tempered safety glass. The material shall conform to the requirements of ANSI Z26.1 Test Grouping 2 and the Recommended Practices defined in SAE J673.	Side window glazing material shall have a 1/4-inch nominal thickness. The material shall conform with the requirements of ANSI Z26.1-1977 Standard for Type AS-5 Safety Glazing Materials except for Test Number 17 which shall subject the specimens to 1000 cycles and the arithmetic mean of the percentages of light scattered shall not exceed 5 per cent. Windows shall be polycarbonate sheet with an abrasion resistant coating on both sides of the window.	Side window glazing material shall have a 1/2-inch nominal thickness. The material shall conform with the requirements of ANSI Z26.1-1977 Standard for Type AS-5 Safety Glazing Materials except for Test Number 17 which shall subject the specimens to 1000 cycles and the arithmetic mean of the percentages of light scattered shall not exceed 5 per cent. Windows shall be cell cast acrylic sheet with an abrasion resistant coating on both sides of the window.

Windows on the bus sides and in the rear door shall be tinted a neutral color, complementary to the bus exterior. The maximum solar energy transmittance shall not exceed 37 percent, as measured by ASTM E-424, and the luminous transmittance shall be no less than 16 percent as measured by ASTM D-1003. Windows over the destination signs shall not be tinted.

5.4.8 HEATING VENTILATING AND AIR CONDITIONING

5.4.8.1 CAPACITY AND PERFORMANCE

The Heating, Ventilation and Air Conditioning (HVAC) climate control system shall be capable of maintaining the interior of the bus at the temperature and humidity levels defined in the following paragraphs.

With the bus running at the design operating profile and carrying a number of passengers equal to 150 percent of the seated load, the HVAC system shall maintain a passenger compartment temperature within a range between 65E and 80E F, while controlling the relative humidity to a value of 50 percent or less. The cooling requirements shall be based on each passenger generating 270 Btu per hour of sensible heat and 270 Btu per hour of latent heat. The system shall maintain these conditions while subjected to any outside ambient

temperatures within a range of 10E to 95E F and at any ambient relative humidity levels between 5 and 50 percent. When the bus is operated in outside ambient temperatures of 95E to 115E F, the interior temperature of the bus shall be permitted to rise one degree for each degree of exterior temperature in excess of 95E.

The air conditioning portion of the HVAC system shall be capable of reducing the passenger compartment temperature from 110E to 90E F in less than 20 minutes after engine start-up. Engine temperature shall be within the normal operating range at the time of start-up of the cool-down test and the engine speed shall be limited to fast idle that may be activated by an operator-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 inches from the surface of the coil, shall be less than 45E F above the condenser inlet air temperature. The bus shall be parked in direct sunlight with ambient temperature at 100E F and humidity less than 20 percent. There shall be no passengers on board, and the doors shall be closed.
Manually controlled shutoff valves in the refrigerant lines shall allow isolation of the compressor and receiver for service. To the extent practicable, self-sealing couplings shall be used to break and seal the refrigerant lines during removal of major components, such as the refrigerant compressor condenser. 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.

5.4.8.2 CONTROLS AND TEMPERATURE UNIFORMITY

All interior climate control system requirements shall be attained automatically. The operator shall control only the defroster and operator's heater. The interior climate control system shall switch automatically to the ventilating mode if the refrigerant compressor or condenser fan fails.

Temperatures measured from a height of 6 inches below the ceiling shall be within ∀5E F of the average temperature at the top surface of the seat cushions. Temperatures measured more than 3 inches above the floor shall be within ∀10E F of the average temperature at the top surface of the seat cushions. The interior temperature, from front to rear of the bus, shall not vary more than ∀5E F from the average.

5.4.8.3 AIR FLOW

5.4.8.3.1 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 feet per minute (cfm) per passenger based on the standard configuration bus carrying a number of passengers equal to 150 percent

of the seated load. This air shall be composed of no less than 20 percent outside air. Airflow shall be evenly distributed throughout the bus with air velocity not exceeding 100 feet per minute on any passenger. The ventilating mode shall provide outside 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. Heated air introduced into the bus shall contain no less than 20 percent outside air. The fans shall not activate until the heating element has warmed sufficiently to assure at least 70E F air outlet temperature. The heating air outlet temperature shall not exceed 100E F under any normal operating conditions. Outside airflow may be cut off during initial warm-up, provided no manual manipulation is required.

5.4.8.3.2 Operator's Area

The bus interior climate control system shall deliver at least 100 cfm of air to the operator'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 operator's feet and legs. The defroster or interior climate control system shall maintain visibility through the operator's side window.

5.4.8.4 AIR INTAKES

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

Outside air shall be filtered before discharge into the passenger compartment. The filter shall meet the ASHRAE requirement for 5 percent or better atmospheric dust spot efficiency, 50 percent weight arrestance, and a minimum dust holding capacity of 120 gram per 1,000 cfm cell. More efficient air filtration may be provided to maintain efficient heater and/or evaporator operation. Air filters shall be cleanable and easily removable for service. Moisture drains from air intake openings shall be located to prevent clogging from road dirt.

5.4.8.5 ROOF VENTILATORS

One ventilator shall be provided in the roof of the bus approximately over the rear axle. The ventilator shall be easily opened and closed manually by a 50^{th} percentile female. When open with the bus in motion the ventilators shall provide fresh air inside the bus. Each ventilator shall cover an opening area no less than 425 square inches and shall be capable of being positioned as a scoop with either the leading or trailing edge open no less than 4 inches, or

with all four edges raised simultaneously to a height of no less than 3-1/2 inches. The escape hatch shall be incorporated into the rear roof ventilator.

Baseline: One Roof Ventilator is Required	*Alternate: Two Roof Ventilators are Required* Two roof ventilators shall be provided in the roof of the bus approximately over each axle. These ventilators shall be easily opened and closed manually by a 50th percentile female. When open with the bus in motion the ventilators shall provide fresh air inside the bus. Each ventilator shall cover an opening area no less than 425 square inches and shall be capable of being positioned as a scoop with either the leading or trailing edge open no less than 4 inches, or with all four edges raised simultaneously to a height of no less than 3-1/2 inches. The escape hatch shall be incorporated into both roof ventilators.

5.4.8.6 STEPWELL HEATERS

Baseline: Stepwell heating is not required	*Alternative: Use if stepwell heating is required.* Heat shall be applied to the front step tread to prevent accumulation of snow, ice, or slush. Stepwell heat shall be controlled by the operator's heater and defroster system.

5.4.9 SIGNAGE AND COMMUNICATION

5.4.9.1 EXTERIOR ROUTE DISPLAYS

5.4.9.1.1 Destination Signs

Baseline: Use for electronic destination sign system.	*Alternative: Use for LCD destination sign system.*	*Alternative: Use for curtain-type*

An automatic electronic destination sign system shall be furnished on the front, on the right side near the front door, and on the rear of the vehicle. Display areas of destination signs shall be clearly visible in direct sunlight and/or at night. The sign system shall provide optimum visibility of the message display units for passengers and shall meet applicable ADA requirements defined in 49 CFR, Part 38.39. Destination signs shall be installed in such a manner as to facilitate easy access for replacement of the entire sign assembly, or components such as fluorescent lamps and electronic control modules, from inside the bus within 30 minutes by a 3M mechanic. Lamps and associated parts shall be commercially available. The front destination sign shall have no less than 1,792 flip-dot pixels, 16 rows by 112 columns, with a message display area of not less than 8 inches high by not less than 56 inches wide. The side destination sign shall have no less than 630 flip-dot pixels, having at least 7 rows and 80 columns with a message display area of not less than 2.7 inches high by not less than 36 inches wide. . The rear route number sign display area shall have no less than 161 flip-dot pixels, having at least 7 rows and 23 columns with a message display area of not less than 6.1 inches high by not less than 13.8 inches wide. The sign shall be capable of displaying 4 alphanumeric characters (1 through 9 and A through Z). The rear route number sign shall be located a minimum of 90 inches above ground on the curb side rear corner of the bus.	An automatic electronic destination sign system shall be furnished on the front, on the right side near the front door, and on the rear of the vehicle. Display areas of destination signs shall be clearly visible in direct sunlight and/or at night. The sign system shall provide optimum visibility of the message display units for passengers and shall meet applicable ADA requirements defined in 49 CFR, Part 38.39. Destination signs shall be installed in such a manner as to facilitate easy access for replacement of the entire sign assembly, or components such as fluorescent lamps and electronic control boards, from inside the bus within 30 minutes by a 3M mechanic. Lamps and associated parts shall be commercially available. The front destination sign shall have no less than 1,689 octagonal dot pixels, 16 rows by 105 columns, with a message display area of not less than 9.8 inches high by not less than 63 inches wide. The side destination sign shall have no less than 672 octagonal dot pixels, having at least 8 rows and 84 columns with a message display area of not less than 3.15 inches high by not less than 30 inches wide. . The rear route number sign display area shall have no less than 448 octagonal dot pixels, having at least 8 rows and 28 columns with a message display area of not less than 6.1 inches high by not less than 11 inches wide. The sign shall be capable of displaying 4 alphanumeric characters (1 through 9 and A through Z). The rear route number sign shall be located a minimum of 90 inches above ground on the curb side rear corner of the bus.	*destination sign system.* Destination signs shall be included on the front and on the right side of the coach near the front door. At least 175 entries shall be available in the display system. Sign readings shall be selected by the driver and shall retain the setting during subsequent operations. Selections for the front and side destination signs shall be powered and controlled with a switch conveniently located near the inspection window of each sign. The switch on the side sign shall be capable of being deactivated from the driver's

Destination messages, route designations, and public relations messages shall be independently selectable via a single Operator's Control Panel (OCP) which shall include a display monitor. The rear route number sign shall be controlled by the same OCP that operates the destination signs. The OCP display monitor readout shall show the exact information displayed on the destination signs and route number sign. The OCP shall be conveniently located for the bus operator and mounted in such a manner that will not pose any safety hazard. The OCP shall utilize a durable weatherproof keypad with tactile feel for destination message control functions. The destination sign system shall be capable of programming 10,000 message lines. The number of public relations messages shall be limited only by the remaining number of message lines not used for destination purposes. Sign displays shall have alternating message capability with programmable blanking time between message lines as may be required. Variable blanking times shall be programmable between 0.5 to 25 seconds in duration. Each line message or blanking time for each message shall be individually programmable. The message display units shall incorporate an automatic blanking feature that will cause the display area to blank within 30 seconds of the bus master power switch being turned off. An emergency message shall be initiated by the closure, or opening, of a dry contact switch or relay. The emergency message shall be displayed on the exterior of the bus only. The OCP shall not display the emergency message. The destination sign shall automatically	Destination messages, route designations, and public relations messages shall be independently selectable via a single Operator's Control Panel (OCP) which shall include a display monitor. The rear route number sign shall be controlled by the same OCP that operates the destination signs. The OCP display monitor readout shall show the exact information displayed on the destination signs and route number sign. The OCP shall be conveniently located for the bus operator and mounted in such a manner that will not pose any safety hazard. The OCP shall utilize a durable weatherproof keypad with tactile feel for destination message control functions. The destination sign system shall be capable of programming 10,000 message lines. The number of public relations messages shall be limited only by the remaining number of message lines not used for destination purposes. Sign displays shall have alternating message capability with programmable blanking time between message lines as may be required. Variable blanking times shall be programmable between 0.5 to 25 seconds in duration. Each line message or blanking time for each message shall be individually programmable. The message display units shall incorporate an automatic blanking feature that will cause the display area to blank within 30 seconds of the bus master power switch being turned off. An emergency message shall be initiated by the closure, or opening, of a dry contact switch or relay. The emergency message shall be displayed on the exterior of the bus only. The OCP shall not display the emergency	compartment. Each sign box or housing shall have an inspection window for the driver to monitor sign selection. The entire area of both signs shall be clearly visible in direct sunlight or at night. The front sign opening shall accommodate entries with letters no less than 5 inches high and shall accommodate a message width no less than 50 inches regardless of coach width. A side sign shall post the same message as the front sign with provisions for characters up to 4 inches high. Provisions

resume normal operation when the remote emergency switch is returned to its normal position. Destination Sign Programming: The electronic sign system shall be programmable via an integral connector located in the front destination sign area. Software shall be furnished for programming the sign system via an IBM-compatible, laptop computer. Software shall be capable of providing a high degree of flexibility to create, or select preprogrammed, fonts and graphic displays. The sign shall have the capability of being programmed in the field using a PC or field programmer. Message program information shall be transferable to and/or from the field programmer device as specified by the Procuring Agency in attachments to Part 5: Technical Specifications.	message. The destination sign shall automatically resume normal operation when the remote emergency switch is returned to its normal position. Destination Sign Programming: The LCD electronic sign system shall be programmable via an industry standard FLASH PC-Card. The PC-Card is carried to each vehicle and inserted into the download slot of each electronic sign. The updated database is transferred from this Master Memory Card (MMC) into the internal FLASH Memory of the sigh system. The MMC shall be capable of being programmed via an IBM-compatible, laptop computer. Software shall be provided and shall be capable of providing a high degree of flexibility to create, or select preprogrammed fonts and graphic displays.	shall be made to mount the side sign anywhere along the coach sides with one location as far forward and as high as practicable. Regardless of location, the side sign shall be easily read from the sidewalk level.

The bus “Master Run” switch shall control power to the sign system. The sign system shall be operable in all switch positions except "Off".

A complete listing of destination sign readings for initial sign programming by the manufacturer are provided in attachments to Part 5: Technical Specifications.

5.4.9.1.2 Bus Block Numbers

An illuminated block number sign box with four characters, 4 inches high, shall be mounted on the dash panel to the right of center of the bus. The sign shall be mounted with a built-in appearance to eliminate glare and reflections in the windshield and shall minimize obstruction of the operator's view. Manual adjustment of the block number sign entry shall be provided from inside the bus with provision for reading the sign during the adjustment operation. Illumination of the sign shall be concurrent with the marker lights. The list of required sign readings is defined in attachments to Part 5: Technical Specifications.

5.4.9.2 PASSENGER INFORMATION AND ADVERTISING

5.4.9.2.1 Interior Displays

Provisions shall be made on the rear of the operator's barrier for a frame to retain information that is sized *(Procuring Agency to specify width)* inches wide and *(Procuring Agency to specify height)* inches high posted by the Procuring Agency, such as routes and schedules. Advertising media 11 inches high and 0.09 inches 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 fluorescent light system.

5.4.9.2.2 Exterior Displays

Provisions shall be made to integrate advertising, which may be specified by the Procuring Agency, 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.

(Additional requirements for exterior advertising may be defined in the attachments to Part 5: Technical Specifications.)

5.4.9.3 PASSENGER EXIT SIGNAL

Baseline: Use for touch tape passenger signal.	*Alternative: Use for 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 touch tape, chime, and interior sign message. The touch tape shall be located the full length of the bus on the sidewalls, towards the ceiling. It shall be easily accessible to all passengers, seated or standing. Vertical touch tape shall be provided at each window mullion and adjacent to each wheelchair parking position and handicap seating positions	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 pull cable, chime, and interior sign message. The pull cable shall be located the full length of the bus on the sidewalls, towards the ceiling. It shall be easily accessible to all passengers, seated or standing. Vertical pull cable shall be provided at each window mullion and adjacent to each wheelchair parking position and handicap seating positions.

Exit signals located in the wheelchair parking area shall be no higher than 4 feet above the floor. Pull cable(s) shall activate a solid state or magnetic proximity switch(s).

A single "Stop Requested" chime shall sound when the system is first activated. A double chime shall sound when the system is first activated from wheelchair passenger areas.

A "Stop Requested" message in red letters shall be illuminated when the passenger "Stop Requested" signal system is activated. The "Stop Requested" message shall remain visible until one or both passenger doors are opened. The message shall be visible to the seated operator and seated passengers. The operator shall be able to deactivate the signal system from the operator's area. A green light shall be mounted above the rear door, approximately on center of the rear door actuator compartment access panel, to indicate when the rear doors have been unlocked.

5.4.9.4 RADIO COMMUNICATION SYSTEM

A location convenient to the operator shall be provided for the radio control head, speaker, handset, and cradle. The location shall conform to SAE Recommended Practice J287 "Driver Hand Control Reach." Provisions for attaching an antenna to the roof and routing an antenna lead to the radio compartment shall include a 3/4-inch inside diameter conduit with a pull wire. The antenna mounting and lead termination shall be accessible from the bus interior. A compartment shall be provided to accommodate a communication system. It shall be located within 8 feet of the operator's seat and shall be connected to the operator's area by waterproof, 2-1/4 inch inside diameter, metallic conduit. The radio compartment shall be supplied with a 30-amp, 12-volt, DC, protected service with positive and negative leads.

The compartment shall include a clear space 12 inches high, 18 inches wide, and 24 inches deep for location of the radio. The bus manufacturer shall provide and install any special brackets, reinforcements and/or other hardware necessary to install the radio equipment in the bus. The compartment may be located under the floor but shall not be located in an area where it is directly subject to road spray from tires and shall not reduce the ground clearances stated elsewhere in this specification. The compartment shall be fabricated in a durable fashion and all seams of the compartment shall be sealed. It shall be accessible from either inside or outside the bus and shall be splashproof when the service door is secured. Securement shall be provided by means of a 5/16-inch "T" lock or keyed lock. If the compartment is located inside the bus it shall not provide any encumbrance to the operator or passengers. If located at floor level, it shall be sealed against moisture from washing equipment including but not limited to power washers, garden hoses, etc.

5.4.9.5 PUBLIC ADDRESS SYSTEM

A public address system that complies with the ADA requirements of 49 CFR, Part 38.35 and enables the operator to address passengers either inside or outside the bus. Inside speakers shall broadcast, in a clear tone, announcements that are clearly perceived from all seat positions at approximately the same volume level. A speaker shall be provided so that announcements can be clearly heard by passengers standing outside the bus near the front door. An operator-controlled switch shall select inside or outside announcements. A separate volume control shall be provided for the outside system if volume adjustment would otherwise be necessary when switching from inside to outside. The system shall be muted when not in use. The microphone shall be vandal resistant, mounted on a heavy-duty, flexible gooseneck, which is secured with tamper-proof fasteners and will allow the operator to comfortably speak into it without using his hands. A provision shall be provided to secure the

microphone in a stored position when not in use. An input jack shall be provided in the operator's area for a hand held microphone.

5.5 ELECTRICAL SYSTEM

5.5.1 GENERAL REQUIREMENTS

The bus shall be equipped with a programmable logic control system that is computer based and completely modular. The programmable logic control collects information received from input devices throughout the bus and then communicates with its system components or other output devices in remote areas of the bus through multiplex wiring system. The entire system will reduce the amount of wiring over a conventional wiring/harness electrical system. Versatility and future expansion shall be provided for by expandable system architecture. The system components shall be capable of operating in an environment of between -20 degrees F to 170 degrees F while encountering mobile shock and vibrations. The system shall store and retrieve data for the mechanical and electrical functions of the bus. All components in the system will be interchangeable. The multiplex power source shall be isolated to avoid any ground noise.

The electrical system shall provide and distribute power to ensure satisfactory performance of all electrical components. The system shall supply a nominal 12 and/or 24 volts of direct current (DC), and employ alternating current up to 220 volts that does not present an electrical shock hazard. Electrical power provided for the fare collection device and the radio compartment shall be 12 and/or 24 volts DC as specified in attachments to Part 5: Technical Specifications. Precautions shall be taken to minimize hazards to service personnel. Transient voltages above 220 volts may be used in the fluorescent lighting system. The power generating system shall be rated sufficiently higher than the total possible electrical load to maintain the charge on the batteries at all operating conditions including the engine at idle. All circuits, except for those involved in propulsion system start-up, shall be protected by circuit breakers or fuses. Fuses shall be used only where it can be demonstrated that circuit breakers are not practicable, and they shall be easily accessible for replacement.

Redundant grounds shall be used for all electrical equipment, except where it can be demonstrated that redundant grounds are not feasible or practicable. One ground may be the bus body and framing. Grounds shall not be carried through hinges, bolted joints (except those specifically designed as electrical connectors), or power plant mountings. Electrical equipment shall not be located in an environment that will reduce the performance or shorten the life of the component or electrical system. To the extent practicable, wiring shall not be located under the bus floor. Wiring and electrical equipment necessarily located under the bus shall be insulated from water, heat, corrosion, and mechanical damage.

5.5.2 MODULAR DESIGN

Design of the electrical system shall be modular so that each major component, apparatus panel, or wiring bundle is easily separable with standard hand tools or by means of connectors. Each module, except the main body wiring harness, shall be removable and replaceable in less than 1 hour by a 3M mechanic. Power plant wiring shall be an independent wiring module. Replacement of the engine compartment wiring module(s) shall not require pulling wires through any bulkhead or removing any terminals from the wires.

5.5.3 WIRING AND TERMINALS

All wiring between electrical components and terminations, shall have double electrical insulation, shall be waterproof, and shall conform to specification requirements of SAE Recommended Practice J1127 and J1128. Except as interrupted by the master battery disconnect switch, battery and starter wiring shall be continuous cables, grouped, numbered, and/or color-coded with connections secured by bolted terminals; and shall conform to specification requirements of SAE Standard J1127-Type SGT or SGX and SAE Recommended Practice J541. Wiring harnesses shall not contain wires of different voltages unless all wires within the harness are sized to carry the current and insulated for the highest voltage wire in the harness.

Double insulation shall be maintained as close to the terminals as possible. The requirement for double insulation shall be met by wrapping harnesses with plastic electrical tape or by sheathing all wires and harnesses with non-conductive, rigid or flexible conduit. Strain-relief fittings shall be provided at points where wiring enters all electrical components. Grommets of elastomeric material shall be provided 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.

All wiring harnesses over 5 feet long and containing at least 5 wires shall include 10 percent excess wires for spares that are the same size as the largest wire in the harness excluding the battery cables. Wiring length shall allow end terminals to be replaced twice without pulling, stretching, or replacing the wire. Except for large wires such as battery cables, terminals shall be crimped to the wiring and may be soldered only if the wire is not stiffened above the terminal and no flux residue remains on the terminal. Terminals shall be corrosion-resistant and full ring type or interlocking lugs with insulating ferrules. T splices may be used when there is less than 25,000 circular mills of copper in the cross section and a mechanical clamp is used in addition to solder on the splice; the wire supports no mechanical load in the area of the splice; and the wire is supported to prevent flexing.

All cable connectors shall be locking type, keyed, and watertight, unless enclosed in watertight cabinets. 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 either use different inserts or different insert orientations to prevent incorrect connections.

5.5.4 JUNCTION BOXES

All relays, controllers, flashers, circuit breakers, and other electrical components shall be grouped according to voltage; and mounted in easily accessible junction boxes. The boxes shall be sealed to prevent moisture from normal sources, including engine compartment cleaning, from reaching the electrical components and shall prevent fire that may occur inside the box from propagating outside the box. The components and circuits in each box shall be identified and their location permanently recorded on a schematic drawing glued to or printed on the inside of the box cover or door. The drawing shall be protected from oil, grease, fuel, and abrasion. The front junction box shall be completely serviceable from the driver's seat, vestibule, or from outside. A rear start and run control box shall be mounted in an accessible location in the engine compartment.

5.5.5 ELECTRICAL COMPONENTS

All electrical components, including switches, relays, flashers, and circuit breakers, shall be heavy-duty designs. These components shall be longest lasting, commercially available, and shall be replaceable in less than 5 minutes by a 3M mechanic. Sockets of plug-in components shall be polarized where required for proper function and the components shall be positively retained. Any manually resettable circuit breakers critical to the operation of the bus shall be mounted in a location convenient to the driver and provide visible indication of open circuits. All electric motors, except cranking motors, shall be heavy-duty brushless type, with a constant duty rating of no less than 40,000 hours. Electric motors shall be located for easy replacement and except for the cranking motor shall be replaceable in less than 15 minutes by a 3M mechanic. Electronic circuit protection for the cranking motor shall be provided to prevent engaging of the motor for more than 30 seconds at a time.

5.5.6 MULTIPLEX WIRING SYSTEM

The components of the multiplex system shall be of modular design, thereby providing for ease of replacement by maintenance personnel. The modules shall be easily accessible for troubleshooting electrical failures and performing system maintenance. Each module shall be shielded to prevent interference by EMI and RFI; and shall utilize LEDs to indicate circuit integrity and assist in rapid circuit diagnostics and verification of the load and wiring integrity. In conjunction with relays if necessary, each circuit shall be capable of providing a current load of up to 10 Amperes. The internal controls shall be a solid state device, providing an extended service life. Wiring for data bus and node module power shall consist of three, 22 gage or larger, UL approved, shielded, twisted pairs.

Ten percent (10%) spare input and output shall be provided at each I/O location. Wiring used for the multiplexing shall be stamped with the address of the corresponding I/O location.

Protection to each individual circuit shall be provided. An automatic test system, integral to the multiplexing, shall be provided. The system shall be hosted on an IBM-compatible personal computer as well as a hand held field diagnostic unit capable of reading the network data, control function and address data, or function code. The mechanic shall be able to use either unit to check bus wire function.

5.5.7 BATTERIES

Batteries shall be easily accessible for inspection and service from only the outside of the bus. The batteries shall be securely mounted on a stainless steel tray that can accommodate the size and weight of the batteries. The battery tray shall pull out easily and properly support the batteries when they are serviced. The tray shall allow each battery cell to be serviced and filled with either manual or automatic equipment. A positive lock shall retain the battery tray in the stowed position.

Baseline: Two 8D Battery Units	*Alternate: Four Group 31 Maintenance Free Batteries*
Two 8D battery units conforming to SAE Standard J537 shall be provided. Each battery shall be fitted with threaded stud terminals and have a minimum of 1150 cold cranking amps. Each battery shall have a purchase date no more that 60 days from date of release for shipment to the Procuring Agency.	Four Group 31 Series deep cycling maintenance free battery units shall be provided. Each battery shall be fitted with threaded stud terminals and have a minimum of 700 cold cranking amps. Each battery shall have a purchase date no more that 60 days from date of release for shipment to the Procuring Agency.

Positive and negative terminal ends shall have different size studs to prevent incorrect installation. The battery terminal ends and cables shall be color-coded with red for the primary positive, black for negative, and another color for any intermediate voltage cables. Battery terminals shall be located for access in less than 30 seconds with jumper cables. Battery cables shall be flexible and sufficiently long to reach the batteries with tray in the extended position without stretching or pulling on any connection and shall not lie directly on top of the batteries. Battery cables must be of sufficient size to carry the load required by the starting motor.

5.5.8 MASTER BATTERY SWITCH

A master switch on the battery positive (+) shall be provided in the battery compartment near the batteries for complete disconnecting from all bus electrical systems. The location of the master battery switch shall be clearly identified on the access panel and be accessible in less than 10 seconds for activation. The master switch shall be capable of carrying and interrupting the total circuit load. Any equipment that requires power without reference to the master battery switch

shall be listed in attachments to Part 5: Technical Specifications. Opening the master switch with the power plant operating shall not damage any component of the electrical system. The location of the master battery switch shall prevent corrosion from fumes and battery acid when the batteries are washed off.

5.5.9 FIRE DETECTORS

At least 2 temperature-sensitive sensors shall be provided. They shall be located in the engine compartment under all horizontal bulkheads, above and downwind of the major heat sources, and in areas likely to be wetted by leaking flammable fluids. Additional sensors shall be located in other potentially critical areas. 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. The sensors shall return to normal setting and deactivate alarms when the temperature returns to normal.

5.5.10 RADIO NOISE ATTENUATION

Proper suppression equipment shall be provided in the electrical system to eliminate interference with radio and television transmission and reception. This equipment shall not cause interference with any electronic system on the bus.

5.6 ATTACHMENTS TO PART 5, TECHNICAL PROVISIONS

PROCURING AGENCY SPECIFICATIONS

The following is a list of those subsections of Part 5, Technical Specifications, which call for each Procuring Agency to attach additional detail.

5.1 General

5.1.2 Definitions (17): *Signing, colors, the destination sign reading list and other information must be provided by the Procuring Agency in attachments*

(21): *In attachments to Part 5: Technical Specifications, the Procuring Agency may relate the skill levels and ratings of mechanics in its operation to the above definitions.*

5.2 Propulsion system

5.2.2 Drivetrain

5.2.2.1. Power Plant

5.2.2.1.1 Engine: *The requirements for specific cold weather starting aids are included in attachments to Part V: Technical Specifications*

5.2.2.2 Mounting

5.2.2.2.3 Hydraulic Systems *(Alternative): Specific systems for which low hydraulic fluid level sensors are required are included in attachments to Part 5: Technical Specifications.*

5.2.2.2.4 Fluid Lines, Fittings and Clamps, and Charge Air Pipework: *Lines within the engine compartment shall be composed of steel tubing where practicable except in locations where flexible lines are specifically required by the Procuring Agency in attachments to Part 5: Technical Specifications.*

5.3 Chassis

5.3.4 Pneumatic System

5.3.4.1 General: A *quick disconnect fitting specified in attachments to Part 5: Technical Specifications, shall be easily accessible and located in the engine compartment and near the front bumper area for towing.*

5.4 Body

5.4.3 Exterior Panels and Finishes

5.4.3.8.1 Access Doors *(with locks): The locks shall be standardized as defined by the Procuring Agency in the attachments to Part 5: Technical Specifications so that only one tool is required to open all major access doors on the bus.*

5.4.3.10 Finish And Color: *Colors and paint schemes shall be in accordance with the attachments to Part 5: Technical Specifications.*

5.4.3.11 Numbering And Signing: *The exact wording, size, color, and location for these signs are found with requirements for other special signs in attachments to Part 5: Technical Specifications.*

5.4.3.12 Exterior Lighting: *Specific number and mounting requirements are defined in attachments to Part 5: Technical Specifications.*

5.4.4 Interior Panels and Finishes

5.4.4.3 Rear End: *Colors, patterns, and materials are defined in attachments to Part 5: Technical Specifications.*

5.4.4.4 Interior Panels

5.4.4.4.1 General: *All materials shall comply with the Recommended Fire Safety Practices defined in FTA Docket 90, dated October 20,1993. Colors, patterns, and materials for the interior trim are defined in attachments to Part 5: Technical Specifications.*

5.4.4.4.5 Headlining: *Colors, patterns, and materials for the headlining are defined in attachments in Part 5: Technical Specifications.*

5.4.4.5 Floor Covering: *Color and material of the floor covering is defined in attachment to Part 5: Technical Specifications.*

5.4.4.7 Fare Collection: *The fare box, including make, model, size, weight, and meter locations, is described in attachments to Part 5: Technical Specifications.*
[Transfer] equipment is defined in attachments to Part 5: Technical Specifications.

5.4.5 Passenger Accommodations

5.4.5.1 Passenger Seating

5.4.5.1.4 Construction and Materials: *Color of the seat material and optional safety padding is defined in attachments to Part 5: Technical Specifications.*
Colors, fabrics, and patterns for the seats and all interior trim is defined in attachments to Part 5: Technical Specifications.

5.4.5.4 Accessibility Provisions

5.4.5.4.1 General: *Specific requirements, including the number of wheelchairs to be accommodated, the tiedown and securement devices, and fold-down seats, are provided in attachments to Part 5: Technical Specifications.*

5.4.6 Operator Provisions

5.4.6.5.2 Structure and Materials: *Color of the operator's seat is defined in the attachments to Part 5: Technical Specifications.*

5.4.7 Windows

5.4.7.4.1 Dimensions *(Cyclone cleaner opening): Minimum size of this opening is defined in attachment to Part 5: Technical Specifications.*

5.4.8 Heating, Ventilating, and Air Conditioning

5.4.8.5 Roof Ventilators: *The requirements for location of these additional roof ventilators shall also be included in the attachment.*

5.4.9 Signage and Communication

5.4.9.1.1 Destination Signs: *Message program information shall be transferable to and/or from the field programmer device as specified by the Procuring Agency in attachments to Part 5: Technical Specifications.*

A complete listing of destination sign readings for initial sign programming by the manufacturer are provided in attachments to Part 5: Technical Specifications.

5.4.9.1.2 Block Numbers: *The list of required sign readings is defined in attachments to Part 5: Technical Specifications.*

5.4.9.2.2: *(Additional requirements for exterior advertising may be defined in the attachments to Part 5: Technical Specifications.)*

5.5 Electrical system

5.5.1 General Requirements: *Electrical power provided for the fare collection device and the radio compartment shall be 12 and/or 24 volts DC as specified in attachments to Part 5: Technical Specifications.*

5.5.8 Master Battery Switch: *Any equipment that requires power without reference to the master battery switch shall be listed in attachments to Part 5: Technical Specifications.*