

**APPENDIX B  
STATE OF MICHIGAN  
PUBLIC TRANSPORTATION**



**MEDIUM DUTY BUS SPECIFICATIONS**

**7-Years/200,000 Miles (Minimum)**

**24 & 28 Passenger Non-lift Buses - Lift Buses with Alternate Seating  
(26 & 29 Foot Buses, Respectively)**



Bureau of Passenger Transportation  
Bus Acquisition & Intercity Transportation Section  
Revised February 2009



**APPENDIX B  
STATE OF MICHIGAN  
SPECIFICATIONS**

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**APPENDIX B**  
**MEDIUM DUTY DIESEL BUS SPECIFICATIONS**  
**STATE OF MICHIGAN**  
**PUBLIC TRANSPORTATION**

7-Years/200,000 Miles (Minimum)

24 and 28 Passenger Non-Lift - Lift Buses With Alternate Seating  
26 and 29 Foot Buses, Respectively

**I. PURPOSE OF SPECIFICATIONS**

These specifications are setting forth the minimum requirements for a two-axle, transit class commercial non-lift bus or a Paratransit type commercial bus equipped with a commercial wheelchair lift. The body shall be mounted on a commercial or recreational vehicle (RV) chassis. The medium duty bus must be capable of seating 24 or 28 adult forward facing passengers or an alternate capacity of ambulatory adult passengers and wheelchair passengers. It shall be fully tested at the Penn State bus test facility in Altoona, Pennsylvania to Federal Transit Administration [FTA] minimum service life category of 7-year or 200,000 miles for a medium-duty bus. As a minimum, buses must meet all applicable Michigan Motor Carrier Vehicle Codes, all applicable Federal Motor Vehicle Safety Standards (FMVSS), and the Americans with Disabilities Act (ADA).

Two bus contracts shall be awarded in this bid. One contract shall be for a metal rollover frame (cage-type) structure while the second contract will be for fiberglass reinforced plastic (FRP) composite structure. Prospective bidders shall bid on one or both of these contracts.

Any successful bidder supplying these buses shall quick title and deliver the bus and the title to the location specified by the State of Michigan, Bureau of Passenger Transportation. Chassis serial number, body number, axle ratio, gross vehicle weight rating (GVWR), seating capacity and paint codes shall be imprinted on a permanent decal(s) or stamped on a metal plate(s) and affixed in the driver's area of the bus (location to be approved by the State).

The bidder shall have a factory dealer with repair facilities and personnel in Michigan or the bidder may be an out-of-state factory dealer with established repair facilities (including a bus lift) and personnel in Michigan. Any in-state facility shall be capable of handling final inspection and corrections required by the State prior to acceptance of the buses after a contract is awarded. A copy of the dealer agreement between the Bus Manufacturer and the designated dealer will be required as part of the bid. Also, repair facilities shall be established throughout the State to provide chassis and body service support to transit agencies to minimize agency travel to reach the nearest repair facility. The successful bidder must be capable of providing parts and service for a period of ten years after the buses have been placed in service throughout the State of Michigan. The successful bidder must be able to supply replacement parts within 5 working days of a request by a transit agency unless the bidder notifies the transit agency that the part is not available for shipment and provides the shipping date when the part will be available.

Regardless of options and seating plan ordered, the successful bidder shall be responsible for certifying that all buses delivered: 1) shall not exceed 95% of front spring and 95% of rear spring capacity rating at ground without exceeding GVWR of chassis as bid (determined by engineering calculated loaded bus axle weights), and 2) bus length when measured bumper to bumper excluding the energy absorbing portion of the bumper shall not exceed 26' 11" in length for the 26 foot bus and shall not exceed 29' 11"

in length for the 29 foot bus. Manufacturers shall comply with the chassis company's quality vehicle manufacturing programs such as Ford's Quality Vehicle Modifier (QVM).

In these specifications any required approvals shall be made by the State. Wherever brand, manufacturer, or product names are used, they are included only for the purpose of establishing a description of minimum quality of the item. This inclusion is not to be construed as advocating or prescribing the use of any particular brand or item or product. For this bid a pre-bid meeting will be scheduled to consider approved equals and exceptions to the bid specifications. A written response will be made for all bidders prior to the bid due date. The State must be able to determine whether the bidder's offered product is or is not equal to the product described in the specifications from information (technical data, test results, and the like) contained in the bid or provided at the pre-bid meeting. All detailed descriptions and specifications provided in the bid must match the product offered for use in the bid.

## II. BODY SPECIFICATIONS

### A. General Design and Construction

**SAFETY:** The chassis and body shall be designed using only prudent, proven engineering principles with all work performed only by professional established firms. The bus purchased shall comply with all State regulations and requirements applicable to the design and manufacture of motor buses for the State of Michigan.

**DRIVER SIZE and COMFORT:** Design criteria of bus purchased shall be for all females from the 5th percentile, to males of the 95th percentile, to be equally as comfortable in using all controls required to safely drive and maneuver the bus. All driver controls shall comply with FMVSS 101, with hand and foot controls required to operate the bus safely, including the placement of exterior adjustable mirrors, positioned to meet this safety requirement.

**QUALITY of WORKMANSHIP:** All labor employed in both the manufacturing and assembly processes of the bus purchased shall be to the highest industry standards. The entire bus shall be within all established engineering tolerances set by all parties involved in the design and production of the bus. All added components shall be installed and positioned according to the component manufacturer's installation procedures which shall be available upon request.

**WELDING:** All welding procedures used throughout the construction of the bus, including materials, qualifications and training of personnel, shall be in accordance with the standards of the American Society for Testing and Materials (ASTM) and the American Welding Society (AWS). Contact surfaces of all material to be welded shall be clean, and free of grease, paint, rust and scale. After welding, all rough edges and surfaces on parts shall be ground smooth and coated with a corrosion inhibiting primer and paint.

**ATTACHMENT HARDWARE:** All rivets, screws, bolts, nuts, washers and other types of fasteners used in the construction process, including those that would be exposed to the elements, shall be of appropriate size and strength rating for the application. They shall be sprayed with or dipped in a rust-resistant coating material, be plated, be stainless steel, or otherwise be made of rust-resistant type material, all of which will pass the 1000 hour ASTM B117 Salt Spray test and the 1000 hour ASTM D2247 Humidity Resistance test. Fasteners used by the respective component manufacturers in their assemblies are acceptable as part of the assembly.

## **B. Body Structure and Exterior Panels**

### **1. Metal Rollover Frame, Cage-type Construction**

- a. The bus shall have a heavy-duty, unit-body structure type. The body structure (rollover frame, cage type of gauge #16 steel, 0.060" or equal, minimum) shall be of durable steel or aluminum construction, and adequately reinforced at all joints and points of stress, with sufficient strength to comply with the FMVSS 220 rollover protection test. All body and floor structural members (tubes, channels, etc.) shall be Gas Metal Arc Welded (GMAC) or equal at each joint. A MIG welding system is acceptable provided it meets the requirements of this specification. Each bidder shall provide certification with the bid that the bus, as bid, meets the FMVSS 220 rollover protection test (see Section VIII).
- b. The bus shall be designed to withstand road shocks, stop and start operations, seasonal weather and road extremes, and other conditions found in Michigan transit bus service. The body shall be securely fastened to the chassis frame structure using a method of uniform attachment consisting of strategically placed rubber isolators/cushions with connector bolts that permit body flexing independent of chassis flexing. Roof, side, front, and back panels shall be secured to the body vertical and horizontal frame members, and these, when fastened to the floor structural members, result in a permanent, fully-integrated structural unit adequately reinforced at all points where stress concentration may occur. The body floor sub-frame assembly, including lower skirt reinforcements, shall be gauge number 14 (.075" thickness) minimum galvanized steel (mill applied), gauge number 16 stainless steel, gauge number 12 aluminum, or cold or hot rolled steel with corrosion resistant coating, each of which shall have equal mechanical and corrosion resistance properties as gauge number 14 galvanized steel as a minimum. Wheelwells shall have minimum yield strength of gauge number 14 (.075" thickness) galvanized steel, gauge number 16 (.060" thickness) stainless steel, or gauge number 12 (.10" thickness) aluminum properly welded or secured with approved corrosion resistant fasteners to the floor structure. The entire body cage and frame including floor structure shall be properly coated with a corrosion resistant coating or a non -water permeable primer/paint. All box type tubing used in the floor structure and sidewall structure from the top of the window down, shall have the interior of the tube coated with corrosion resistant material as outlined in Rustproofing/Undercoating Section II., M. All components treated to resist corrosion shall be properly cleaned to remove greases, oils, and residues before application of the corrosion resistant material. Passage holes provided for wiring and hoses shall be thoroughly sealed to prevent dust and moisture intrusion. When completed, all body side sections and roof sections including structure shall be at a minimum 1/4" thick. Where body segments are joined they shall be properly sealed to prevent intrusion of drafts, fumes, dust, and water to the interior of the bus body.
- c. All exterior side and roof panel material shall be gauge number 20 (.035 thickness) galvanealed steel, or metal of equal mechanical properties, minimum. If fiberglass it shall have as a minimum the mechanical properties equal to gauge number 20 (.035" thickness) steel according to American Society of Mechanical Engineers (ASME) industry standards and must have State approval. The corners, transitions, front panels, and other locations requiring additional strength shall use steel or other metal with mechanical properties to match the structural integrity

requirements. Reinforcements shall be installed around all window openings in order to transfer stress around the opening. All door openings shall have full structural framing (tube) or imbedded reinforcements, equal to the structural members of the body that will adequately support concentrations of stress around openings. All exposed door frame structure shall be made of 304 stainless steel (including the fasteners), which does not discolor with age. Where a stiffener or a backer material (substrate) is used for the exterior panels, it shall be bonded with waterproof adhesive to the exterior panel; it shall be a water resistant material that will not wick water; and it must be thoroughly sealed from the elements when installed so that the substrate will not be exposed to or absorb moisture and cause corrosion to the interior of the panel or any body structure. Exterior panel substrate shall not be of wood composition, plywood or a pressed wood product. Where body segments are joined they shall be properly sealed to prevent intrusion of drafts, fumes, dust, and water to the interior of the bus body.

- d. All interior panels and trim may be made of scuff-resistant laminate/FRP or molded ABS finished material. Interior panels shall have as a minimum the physical properties of gauge number 24 (.024" thickness). Interior panel threaded fasteners or rivets shall secure panels to body framing structure. Where fasteners are in the panels only, a reinforcing nut or reinforcing panel shall be installed for added strength and fastener retention.
- e. Exterior lower skirt panels may be metal or fiberglass and shall be sufficiently stiff to prevent vibration, drumming, or flexing while the bus is in service. Body front and/or rear endcaps may be molded fiberglass panels installed with required structural framing or a FRP composite structure. Highly corrosion resistant metal lower-skirt panels shall consist of compatible materials not subject to electrolysis and shall be sufficiently fastened and braced to prevent damage from ice and snow build-up. Metal lower skirt panels shall be properly coated to resist corrosion (exterior and interior), see Section II., Part M., Undercoating. Lower skirt panels may be one piece in length at manufacture but shall be repairable in sections. Lower skirt panels shall not use a wood substrate material for a panel stiffener. Where exterior panels are lapped, the upper or forward panels shall act as a watershed. Exterior panels that are cut shall have the cut edge sealed (paint or special sealing compound). Sealing and fastening of panel joints, including front and rear cap-to-body joints, shall prevent entrance of moisture and dirt. Joint sealing shall be made through use of a non-shrinking bonding sealant, and joint sealing shall not be solely dependent on an exterior trim strip or a trim cap nor shall the sealing of the panels be dependent on caulking alone. All exterior panels shall be buck riveted and/or bonded to the body frame structure. Exterior metal panels shall be given a thorough anti-corrosion treatment.
- f. The exterior body panels shall have on each side one heavy-duty rubrail. Rubrails (1½" x ½" minimum) shall be extruded solid aluminum or extruded UV resistant plastic with a flexible, rubber-type resilient material insert or a solid rubber-type of flexible, resilient material. Rubrails shall be located no less than 25" nor more than 43" above the ground on each side. Rubber fender splash guards shall be installed on front and rear wheel openings. Where the rubrails and fender opening guards are not an integral part of the body, installation of rubrails and fender opening splash guards shall be made after the finish coat of paint is applied to the bus.

- g. Gun installed huckbolt fastenings, buck rivets, bonding adhesives, or approved equivalent shall be utilized on all exterior body panels, rubrails, and all other locations where stress is concentrated. All rivets, screws, bolts, nuts, washers, clamps, and other types of fasteners used in the construction process, including those that would be exposed to the elements, on the exterior and interior of the unit shall be properly plated to resist corrosion. No sheet metal screws shall be permitted, except for rubrails and rubber fender splash guards which can be secured with stainless steel or equivalent plated locking-type, self-tapping fasteners. Fastener materials shall be compatible with materials being fastened. Where self-tapping fasteners are used, body panels shall be reinforced with steel backing, aluminum backing, or stainless steel backing.
- h. Window openings cut into body panels shall have a maximum frame clearance of  $\frac{1}{8}$ " on each side to minimize the need for caulking (see Section II. V., Windows). All openings cut into metal body exterior panels must have the exposed cut edges primed or properly coated to inhibit water intrusion and corrosion before further assembly or painting occurs. Window frames installed in the body openings shall be properly caulked/sealed to prevent intrusion of moisture and dust.

## **2. Fiberglass Reinforced Plastic (FRP) Composite Unitized-type Body**

- a. The bus body shall have a heavy-duty unitized structure and shall be of durable fiberglass reinforced plastic (FRP) composite construction. The body panels shall consist of an exterior high gloss gelcoat (.020" thickness, minimum) on a resin-hardened FRP (3/16" thickness, minimum) attached to a center layer of resin hardened Nida-Core<sup>®</sup> or equal honeycomb ( $\frac{3}{4}$ " thickness, minimum) with an inner FRP panel (3/16" thickness, minimum); or may be  $\frac{3}{4}$ " polyurethane foam insulation gelcoated to  $\frac{1}{4}$ " FRP exterior with  $\frac{1}{4}$ " FRP interior, reinforced with steel perimeter and transverse supports, completely fiberglassed to adjoining body parts. It shall use proper adhesive materials to adequately bond and mechanically fasten all joints and points of stress with sufficient strength to comply with the FMVSS 220 rollover protection test. Each bidder shall provide certification with the bid that the bus as bid meets the FMVSS 220 rollover protection test (see Section VIII).
- b. The bus shall be designed to withstand road shocks, stop and start operations, seasonal weather and road extremes, and other conditions found in Michigan transit bus service. The body shall be securely fastened to the chassis frame structure using a method of uniform attachment consisting of strategically placed rubber isolators/cushions with connector bolts that permit body flexing independent of chassis flexing. Roof, side, front, and back panels shall be secured to the floor and lower body frame members; all of which shall result in a permanent, fully-integrated structural unit adequately reinforced at all points where stress concentration may occur. The body floor sub-frame assembly, including lower skirt reinforcements, shall be gauge number 14 (.075" thickness) minimum galvanized steel (mill applied), stainless steel, aluminum, or cold or hot rolled steel with corrosion resistant coating (including steel treated with a sprayed on coating), each of which shall have equal mechanical and corrosion resistance properties as gauge number 14 (.075" thickness) galvanized steel as a minimum. Wheelwells shall have minimum yield strength of gauge number 14 galvanized steel, gauge number 16 (.060" thickness) stainless steel, or gauge number 12 (.10"

thickness) aluminum properly welded or secured with approved corrosion resistant fasteners to the floor structure. Passage holes provided for wiring and hoses shall be thoroughly sealed to prevent dust and moisture intrusion. The entire lower body frame shall be coated with corrosion resistant primer/paint (steel) or properly treated to resist corrosion (other materials). All treated components shall be properly cleaned to remove greases, oils, and residues before application of the corrosion resistant material.

- c. All exterior side and roof panels when completed shall be at a minimum 1 1/8" thick. Bond lines at the side walls, rear endcap, roof, and front cap shall be interlocked by adhesives, resin saturated fiberglass matting, and mechanical fasteners, forming a unibody design without exposed fasteners or protruding moldings. Imbedded reinforcements shall be installed at all door openings in order to support door mounting hardware and door operating mechanisms. All door openings shall have full structural framing to maintain integrity of the body structure. All exposed door frame structure shall be made of 304 stainless steel (including the fasteners), which does not discolor with age. Where a stiffener or a backer material (substrate) is used for the exterior panels, it shall be bonded with waterproof adhesive to the exterior panel; it shall be a water resistant material that will not wick water; and it must be thoroughly sealed from the elements when installed so that the substrate will not be exposed to or absorb moisture and cause corrosion to the interior of the panel or any body structure.
- d. Interior panels may be an integral part of the FRP composite panel or may be made of scuff-resistant laminate/FRP finished material. Where threaded fasteners are in the interior panel only, an imbedded reinforcing nut or a reinforcing panel shall be integrated into the FRP composite for added strength and fastener retention.
- e. Exterior panels may be an integral part of the FRP composite panel. Exterior panels shall be sufficiently stiff to prevent vibration, drumming, or flexing while the bus is in service. Lower skirt panels shall be sufficiently fastened and braced to prevent damage from ice and snow build-up. Lower skirt panels may be one piece in length at manufacture but shall be repairable in sections. Where panels are lapped, the upper and/or forward panels shall overlap the lower and/or rearward panels to prevent intrusion of water under the panels. Sealing and fastening of joints, including front and rear cap-to-body joints, shall prevent entrance of moisture and dirt. All exterior panels shall be bonded to the lower body frame. In no case shall the sealing of the panels be dependent on caulking alone.
- f. The exterior body panels shall have on each side one heavy-duty rubrail. Rubrails (1 1/2" x 1/2" minimum) shall be extruded solid aluminum or extruded UV resistant plastic with a flexible, rubber-type resilient material insert or a solid rubber-type of flexible, resilient material. Rubrails shall be located no less than 25" nor more than 43" above the ground on each side. Rubber fender splash guards shall be installed on front and rear wheel openings. Where the rubrails and fender opening guards are not an integral part of the body, installation of rubrails and fender opening splash guards shall be made after the finish coat of paint is applied to the bus.

- g. No sheet metal screws shall be permitted, except for rubrails and rubber fender splash guards which can be secured with stainless steel or equivalent plated locking-type, self-tapping fasteners. Fastener materials shall be compatible with materials being fastened and meet the 1000 hour ASTM B117 Salt Spray test and the 1000 hour ASTM D2247 Humidity Resistance test. Where self-tapping fasteners are used in body panels, the body panels shall have an imbedded reinforcing nut or a reinforcing panel shall be integrated into the FRP composite for added strength and fastener retention.
- h. Window openings cut into body panels shall have a maximum frame clearance of  $\frac{1}{8}$ " on each side, to minimize the need for caulking (see Section II. V., Windows). All openings cut into body exterior panels must have the exposed edges of the cutout properly coated to prevent moisture intrusion before further assembly or painting occurs. Window frames installed in the body openings shall be properly caulked/sealed to prevent intrusion of moisture and dust.

### **C. Passenger Door**

1. The manufacturer shall provide a heavy duty electrically operated passenger entrance door. The passenger entrance door shall be a split-type double leaf swing door. This door shall have a flexible soft rubber cushion on the meeting edge  $1\frac{1}{2}$ " in width, minimum. The door glass shall be see-through, AS-2 tint (70% luminous transmittance) safety glass. Under all operating conditions and bus speeds, an airtight, watertight, and dust-proof seal shall be formed between the door and the stepwell, between the door and body opening, and between the door leaf sections. The door leading edge opening speed shall not exceed 18 inches per second and the closing speed shall not exceed 12 inches per second to provide a total door closing or opening in 2 to 4 seconds. The front passenger entrance door shall not extend below the step frame. The door shall be located on the right side of the bus near the front wheel. Any door with an exposed (metal showing) outer frame shall be made of 304 stainless steel (including the fasteners), which does not discolor with age. The entrance door shall provide a 30" clear width opening, minimum. Door opening height from the top of the first step to the door header shall be a minimum of 76". Where interior height is low at the entrance header, the header shall be padded to prevent injury to those exiting the bus.
2. The door frame strength and electric door operator strength shall be designed to match the entrance door size. The operator for the entrance door shall be located in an overhead compartment above the passenger entrance doorway; shall be concealed from passengers; and shall be easily accessible for servicing through a hinged access door. The access door shall be hinged to open up with a holding device and shall be as large as will fit in the overhead compartment space. Door motor operation shall be limited electrically to control door travel at full open and full closed positions and shall be adjustable to keep the door closed during bus operation. Physical door stops shall be used to prevent marring or damage to doors and/or surrounding parts. An entrance door manual release that allows disconnection and simple re-engagement of the door operator shall be provided so that the entrance doors can be manually opened in the event of loss of electrical power or other emergency. The door operator motor shall not run continuously when the manual release is operated. Electric door operator, door linkage, and baseplate components shall be of a single manufacturer. Suggested source: A&M Systems Inc., Excell, Vapor.

3. The passenger door control switch shall be located in the driver's compartment within easy reach of the driver and be clearly marked for "open" and "close" (switch shall operate the same on all buses). The control switch shall be powered by a constant battery feed circuit with circuit breaker protection. The control switch shall be "hold on" for operation and of a different color than the standard switch.
4. A method shall be provided to lock all entrances to the bus when it is not in use.

#### **D. Passenger Stepwell**

All entrance steps and stepwells shall be gauge number 14 (.075" thickness) stainless steel, minimum. Steps and stepwells shall have adequate structural bracing. All metal trim hardware in the stepwell area shall be stainless steel. All fasteners in the stepwell area shall be stainless steel which will pass the 1000 hour ASTM B117 Salt Spray test and the 1000 hour ASTM D2247 Humidity Resistance test. Ground to first step shall not exceed 12" in height, each additional vertical step shall not exceed 9½" and all tread depths shall be 9" minimum. All steps in the entrance stepwell shall be of the same width. A suspension kneeling feature may be used to achieve the required 12" step height. Stepwells shall be covered with flooring material as described in Flooring, Section II., F., Item 3). Any interior stainless steel except for exposed door frames shall be brushed, not painted.

#### **E. Interior**

1. The interior of the bus shall provide a pleasant, aesthetically pleasing atmosphere. The door and driver instrument panel are to be painted or otherwise finished with a nonreflective, anti-glare finish which matches the overall interior tones of interior panels. All interior hinged access doors shall use SouthCo Model #M1-61-1 or equal latch to hold the door positively closed. All interior markings shall be durable materials affixed to the interior panels' smooth surfaces or markings shall be durable materials affixed to metal plates fastened to the interior panels of the bus. The interior design and colors shall be approved by the State.
2. All interior panels may be made of scuff-resistant, textured paint on steel, or laminate/FRP finished material. A light grey color shall be installed in the interior area above the seat rail lines, in the ceiling area, and on the rear endwall. All materials and treatments shall be easily cleaned. Panel fastening devices shall match color of panels. All interior finished surfaces shall be impervious to diesel fuel, gasoline, and commercial cleaning agents. Finished surfaces shall not be damaged by controlled applications of graffiti-removing chemicals.
3. The interior height of the passenger compartment at center aisle shall be 74" minimum. At 6" from the sidewall there shall be 67" of interior height, minimum, with a gradual contour to the center aisle (no bulkheads). Interior headroom at the back of bus (rear air conditioning evaporator area) may be reduced to a minimum of 60", but it shall increase to the normal ceiling height at the front of the rear seat cushion. The interior width at seat line shall be 90", minimum.
4. All surfaces, items, or hardware in the passenger compartment having sharp edges, corners, or angles that could cause injury, shall be padded with a heavy-duty, vinyl-covered, energy absorbing material to match interior colors. Areas inside the passenger compartment of low headroom where a person is prone to strike his head shall be marked and padded. All handrails shall have rounded edges where exposed.

5. A storage area with a hinged, lockable, access door shall be provided in the interior area either above the windshield (without destination sign) or on the side above the driver as space permits. This area above the windshield shall also be constructed to adequately support 60 pounds of two way radio communication equipment. A restraint shall be installed to prevent any storage door from opening beyond 105° when the installation allows the door to swing down to open.

## **F. Flooring**

1. The floor deck may be integral with the basic structure or mounted on the structure securely to prevent chafing or horizontal movement. All floor fasteners shall be corrosion resistant steel and shall remain secured and corrosion resistant for the service life of the bus. The floor deck shall be ¾" C/D plywood of marine grade material, minimum, with sealed edges to prevent moisture intrusion. The floor deck upper surface shall have all cracks and voids filled and the whole surface rough sanded before installing the flooring material. A layer of sealer shall be installed between floor deck edges that butt against structural members and other deck sections to prevent dust and moisture intrusion. Passage holes provided for wiring and hoses in the floor deck shall be thoroughly sealed to prevent dust and moisture intrusion. Passenger seating floor rail/track shall not be installed in the wheelchair lift or wheelchair securement areas. The floor deck, including the sealer, attachments, and coverings, shall be waterproof, non-hygroscopic, resistant to wet and dry rot, resistant to mold growth, and impervious to insects. The floor deck shall not be sandwiched between the wall structural members and the floor structural members.
2. The stepwell, entrance area, and center aisle floor area shall be overlaid with ribbed, slip resistant, oil resistant commercial 1/8" floor and 3/16" step tread thickness. Suggested Sources: RCA Rubber Transit-Flor<sup>®</sup>, Rubber Solutions N.A., SMI SpecFlor.
3. The aisle to door area flooring joint shall make a miter so that aisle and door area flooring grooves line up for easy cleaning.
4. The 1/8" thickness flooring under the seats and in the wheelchair area shall be smooth, slip resistant, oil resistant. The flooring shall extend up the sidewall and rear wall to the seat rail line and shall be coved at the floor/wall joint to form a smooth water-tight transition. Flooring adhesive shall be oil resistant. Suggested Sources: RCA Rubber Transit-Flor<sup>®</sup>, Rubber Solutions N.A., SMI SpecFlor.
5. Step treads shall be one-piece ribbed rubber flooring with steel backing plate. Each tread shall have a band of bright yellow contrasting color molded in the full width of the step (must meet ADA contrast requirement). Step tread to stepwell joints shall be sealed to prevent intrusion of moisture and debris.
6. An aisle width standee line of bright yellow contrasting color shall be placed crosswise in the aisle just behind stepwell (must meet ADA contrast requirement).
7. Color of all flooring and step treads shall be equal to RCA Rubber Transit-Flor<sup>®</sup> grey (#766) or tan (#777) as requested by the agencies.

8. To provide easy access for service, the floor shall have a vapor and fumeproof bright aluminum diamond plate access panel to reservoir fill/check areas and fuel tank sending unit.
9. Wheelwells shall be thoroughly sealed to prevent intrusion of moisture and dirt. Metal wheelwells inside the passenger compartment shall be covered with flooring material or molded fiberglass (FRP or ABS).
10. Standee decals shall be furnished and mounted at the center of the bus above the windshield.

#### **G. Emergency Exits**

1. Each bus shall be equipped with a rear exit door with an minimum opening of 1296 square inches with a minimum size of 24" by 54" (a rear exit window in place of the door is optional). All exposed exit door frame/jamb structure shall be made of 304 stainless steel, a grade which does not discolor with aging. The rear door exit and side window exits shall meet federal requirements of FMVSS 217. The manufacturer shall provide a method to lock the rear exit door. The rear exit door shall have an audible alarm at the driver's area activated when the exit door latch handle starts to open and when the exit door is locked with the ignition on. A bus with a rear exit door shall have one small window on each side of the exit door in the rear endcap.
2. The rear exit door shall have two windows, an upper window and a lower window, as a part of the door. The door glass shall be see-through, AS-2 tint (70% luminous transmittance) safety glass. The upper door window height shall match top of rear bus windows, one on each side of rear door. Door windows shall match design of bus rear windows. Heavy-duty door latch mechanism with handle guard shall provide a quick release for opening from inside and outside the bus but be designed to offer protection against accidental release. The door latch shall cause the door to compress the perimeter door seal to provide an airtight, dustproof and watertight seal around the door under all operating conditions and speeds. Door panels shall match exterior and interior body panels (see section II. A., B., and C.). All doors shall be fitted with screwed or bolted-on heavy-duty stainless steel piano hinges or heavy duty hinges of a noncorrosive material. A restraint shall be installed to prevent the door from opening beyond 105° or striking the rear panel of the bus when the door is opened.
3. A passage way of 16" minimum width shall be provided to the rear exit door. No seats or other objects shall be placed in bus which restricts passageway to rear exit door.
4. One non-closing static exhaust vent, a combination roof vent-emergency exit (23" by 23" minimum), shall be installed at the mid point on the longitudinal center line of the roof of the passenger section of the bus. The roof vent-escape hatch shall provide fresh air flow inside the bus when opened and when the bus is in a forward motion. The escape hatch shall have an inside and an outside release handle. There is no warning buzzer requirement for the escape hatch. Suggested source: DMA 1122, Specialty Manufacturing Co., Transpec Inc.
5. Instructions for proper use of all emergency exits shall be marked in close proximity to the release mechanisms. All interior markings shall be durable materials affixed to the interior panels' smooth surfaces or markings shall be durable materials affixed to metal plates fastened to the interior panels of the bus. Instructions may be labels, of contrasting

color, affixed to a location that shall be approved by the state. All emergency exits shall be marked on the exterior of the bus.

6. Lever-type latches used for emergency windows shall secure the windows tightly shut, shall be easily operated, and shall not unlatch due to vibration during bus operation. The latches shall be made of non-corrosive materials and be designed for minimal maintenance needs.

## **H. Gauges**

Chassis Original Equipment Manufacturer (OEM) gauges shall be used in the driver's instrument cluster, but if they are not available, VDO brand gauges or Stewart Warner gauges shall be used. Each bus shall have an instrument cluster with the following non-glare needle-type gauges which are easily monitored by sight from the driver's position (lights in lieu of gauges are not acceptable).

1. Voltmeter and its wiring shall be compatible with generating capacities.
2. Engine oil pressure gauge.
3. Engine coolant temperature gauge.
4. Fuel gauge.
5. Air system pressure gauge with low air warning alarm and light for buses with an air system.

## **I. Farebox**

1. The farebox (a donation box is optional) shall be mounted with the trip handle toward the driver and within easy reach of the driver. The farebox shall be mounted on an adequately braced stanchion; shall be located over a flat floor surface near the driver; and shall be accessible to passengers entering the bus (meet ADA requirements). An indirect farebox light shall be connected through an entrance door jamb switch to the running light circuit.
2. The farebox shall be lockable and supplied with two vaults that are interchangeable and lockable (2 keys for each lock). The vaults shall be keyed alike. The vault and farebox exteriors shall be marked with key reference. (Location shall be approved by the State at pilot model inspection.) Suggested source: Main Farebox Model M-4.

## **J. Bumpers**

The front bumper shall be an OEM bumper. The rear bumper shall be a high energy absorbing bumper. The rear bumper shall be installed per bumper manufacturer's specifications. Bumper attachment shall use a minimum of SAE grade 8 fasteners with thread locking feature or other shake-proof (Nord-Lock) mounting in all attachment brackets. Rear anti-ride bumper installation shall allow space between the bumper and the body for energy absorption movement without body damage. Lifting pads shall be provided as part of the bus so that the bus may be lifted (at curb weight) at the front and/or the rear without any deformation or damage to the bus or bumpers and mounting hardware. Rear bumper Suggested source: H.E.L.P. bumper, Romeo R.I.M. Inc. .

## **K. Mud Flaps**

The bus shall have commercial grade anti-sail mud flaps/splash aprons behind front and rear wheels which contain no visible imprinted logo or advertising. An inverted "T" bracket shall be used to prevent the wind movement of the mud flap when the bus is in motion. The flaps/aprons shall be securely fastened with full width metal strips and appropriate fasteners. The flaps/aprons shall be compressed between a gauge number 11 (.125" thickness, minimum) support bracket and a gauge number 14 (.075" thickness, minimum) metal strip. The support bracket shall be fastened securely to the body substructure or chassis frame. The flaps shall extend to within 6" of the road surface at curb weight. The mud flaps/aprons shall be at least 1" wider than the tire widths (single front, dual rear) to control splash at the rear of wheel openings. Rubber fender splash guards, secured with stainless fasteners shall be installed on all wheelwell openings. Other mud flaps/splash aprons/shields shall be installed to protect bus equipment (AC components, batteries, front wheel inner shield, auxiliary heater box, and the like) from road splash.

## **L. Towing**

Tow hooks shall be provided with two in the rear and two in the front of the bus, which shall be of sufficient strength to tow 1½ times the GVWR of the bus. Tow hooks shall be easily accessed and free of interference with the bumper system when in use. Access to tow hooks may be made through holes in the bumper assembly. The intended use for tow hooks is only to safely move the bus to a point of tow truck hook-up. Tow hooks shall be installed to prevent them from dragging when the bus is driven over an incline. The tow hooks, equal to Original Equipment Manufacturer (OEM) units, shall be mounted and adequately secured to the chassis frame as recommended by the tow hook manufacturer or may be supplied by the OEM as standard equipment on the chassis. The bus shall be designed to be towed from the front or from the rear with either a frame contact or a wheel lift. A fuel tank protection frame shall not interfere with a frame contact lift. The bidder shall provide the towing and lifting procedure to be followed.

## **M. Undercoating/Rustproofing**

1. When the unit is completed, the sections of the underside of the bus exposed to the elements shall be treated with an undercoating material except those areas of the OEM chassis where undercoating is not recommended. Undercoating shall be warranted for the same period covered by the body/structure warranty. Suggested source: Tectyl 121-B.
2. Rustproofing - All box type steel tubing (except stainless steel) used in the floor structure and sidewall structure from the top of the window down, shall have the interior of the tube coated with corrosion resistant material conforming to MIL-C-62218 as outlined in Federal Standard 297E. Sections that are treated shall be properly cleaned to remove greases, oils, and residues before application of the corrosion-proofing material. All mechanisms (moving or stationary parts) that are affected by or rendered useless by an application of sealant or insulation shall be cleaned free of sealant or insulation including vent canisters and drain pipes. Rustproofing shall be warranted for the same period covered by the body/structure warranty. Suggested source: Waxoyl, Ziebart Type-A.

## **N. Interior Mirrors/Sunvisors**

### **1. Interior Mirror**

Interior mirror (with adjustable mounting bracket) shall be a 4" by 14" flat mirror glass with rounded corners, minimum. The driver shall be able to adjust the mirror so that the complete passenger compartment can be viewed through interior mirror. Location shall be determined at pilot model inspection. Suggested source: B&R Manufacturing, ROSCO (with bracket).

### **2. Sun Visor**

Windshield sun visor system shall be standard Original Equipment Manufacturer (OEM) chassis visor(s). If the OEM chassis is not equipped with a windshield sun visor, two large transit-type, fully adjustable, double-knuckle, arm-type plexiglass sun visors shall be provided for the driver at the windshield, and at the side window. Location shall be determined at pilot model inspection. Suggested source: OEM or Manufacturer's standard.

## **O. Exterior Mirrors**

1. Each bus shall be equipped with exterior left-hand and right-hand rear view mirrors of flat glass with convex mirrors (3" in diameter, minimum) attached or a combination flat/convex glass in a single mirror head. The mirror shall contain at least 70 square inches of flat glass viewing area. Suggested source: B&R Manufacturing, OEM, Mirror Lite Co, Inc., ROSCO.
2. To prevent obstructed front and right-hand view, a convex 15 degree radius (curvature) exterior crossview mirror (8" minimum diameter) shall be provided on the left front corner of the bus. Suggested source: Manufacturer's standard.
3. All exterior mirrors shall be constructed with high impact plastic or stainless steel housings. Mirrors shall be remote adjusting and shall move independently of the mirror housing. The mirrors shall be modular in design so that the glass can be replaced using the "twist lock" mechanism for service without removing the entire mirror assembly from the bus.
4. Mirror mounting points shall be reinforced when not in a structural frame member, with approval by the State at the time of pilot model inspection. The mirror placement shall not obstruct driver vision nor have window divider bars between the driver and mirror face. Final location of exterior mirrors shall be determined at pilot model inspection.

## **P. Seats**

### **1. Driver's Air Suspension Seat**

- a. The driver's seat shall be an air suspension seat with mounting base (riser), headrest, and armrests and meet the flammability requirements of FVMSS 302. The seat shall comfortably hold and support the human body in the orthopedically correct position for driving. It shall be adjustable so that occupants ranging in size from the 5th percentile female to the 95th-percentile male may be accommodated to operate the bus. The solid bar stock scissors style 12"

minimum exterior width suspension system shall have two dampeners that resist force in both directions, be rubber bumper cushioned at the bottoming out point, and be mounted above the fore and aft slide. The driver's seat with arm rests shall have adjustments for: 1) vertical height, 4" minimum travel; 2) fore and aft slide, 8" minimum travel; 3) back recline, from 60E to 110E minimum: seat tilt, 8 degrees minimum at any seat height; and 4) weight range capacity up to 300 pounds. While seated, the driver shall be able to make all seat adjustments by hand without complexity, excessive effort, or being pinched. Manually operated adjustment mechanisms shall hold the adjustments and shall not be subject to inadvertent changes and have latches and operating controls on both sides of the seat. The seat shall be high-backed with headrest and shall have 3 air adjustable lumbar supports and adjustable side bolsters in the region of the back frame. Individual switches shall control the air supply for the lumbar adjustments and the air supply shall be from the bus's engine air compressor or from the seat's own external electric air compressor system. A check valve shall be installed to prevent loss of air from the weight control bladder when there is a loss of air supply to the seat. The seat shall have a dust seal (bellows) to enclose the mechanism and seat mounting base. The seat and the seat mounting base shall be properly aligned behind the steering wheel to allow for maximum seat adjustments and driver comfort. No part of the bus directly behind the seat shall interfere with the seat back for a recline of 15° when the seat is positioned furthest from the steering wheel. FMVSS Certified seat belt with integrated shoulder harness and an automatic retractor shall be attached to seat frame as an integral part of the seat unit. All seats and seat mountings shall meet applicable federal standards. Suggested source: USSC Model 9100ALX3, Recaro Ergo Metro with headrest and armrests.

- b. The driver's seat cushion shall be molded high resilient (HR) polyurethane foam padding with indentation load deflection (ILD) 35 pounds minimum, and the back cushion shall be molded or fabricated high resilient (HR) polyurethane foam padding (ILD) 25 pounds minimum. There shall be no welt or bead across the front of the seat cushion under the driver's legs. Compressions to 10 percent maximum and tensile strength, 15 lbs. per square inch minimum. Seat and back cushion foam shall meet the typical physical properties of ASTM D-3574 and the flammability requirements of FVMSS 302.
- c. The driver's seat covering shall be gray Cloth-type Woven Fabric (with flame retardant qualities) meeting the requirements listed below in All Seats, Part 4.

## **2. Passenger Seats**

- a. All passenger seats shall be mid-back and are required to meet the following:
  - (1) Complete White Book tests
  - (2) All applicable FMVSS testing including FMVSS 210
  - (3) Comply with cloth-type woven and vinyl fabric seat covering material test and performance criteria of the Federal Register dated October 20, 1993 (see Section IX., table 1).
- b. Two passenger, forward facing seats shall be 35" minimum width with a non foam yellow, energy absorbent vandal-proof grab handle mounted to the top of

each seat back (two per double seat). Grab handles are not required on seats that have a back against a wall.

- c. Single passenger seats shall be 17½" minimum width with an energy absorbent vandal-proof grab handle mounted to the top of the seat back.
- d. Forward facing seats shall have 27" minimum knee to hip room.
- e. Aisle facing seats shall have arm rests on both ends if the seat is not against a modesty panel.
- f. Aisles shall not be less than 16" wide except as noted in Part 3 of this section.
- g. Suggested sources: American Seating Horizon™ 8535 Mid-Back Series; Freedman Feather Weight.

### **3. Wheelchair Lift-Equipped Buses**

Forward facing (double) fold-away seats with seat belts shall be provided in the wheelchair securement area per seating arrangements (see Section III, Wheelchair Securement Area). Fold-away seats shall include all dimensional, structural and testing requirements of the standard seat specification. Seat locking/latching devices shall be of high quality and be easy to latch and unlatch. Seats must positively latch in the seated and folded position to prevent inadvertent folding or unfolding of the seat. Any support legs resting on flooring shall be non-marring or rest on metal plates flush mounted with flooring. All fold-away seats shall be able to pass FMVSS 210 without having to fasten additional latches or cables. All fold-away seats shall fold against the wall when wheelchair space is required (no further than 12" from wall in the vertical folded position). Seat may not extend into bus more than 37½" (two passenger) and 18½" (1 passenger) when folded down for passenger seating. Aisle space may be reduced to 14" inches where fold-up seating is placed on each side of the aisle or 15½" where placed opposite a stationary seat. The seat bottom cushion shall be a 5 degree tilt up from level, minimum, and back cushion shall be at 95 degrees, minimum. The seats shall be of the same design as the other passenger seats. All seat backs and all seat bottoms of fold-away/fold-up seats shall be covered with material matching seat cushion color and fabric. Suggested source: American Seating Horizon™ 8535 Mid-Back Series; Freedman Feather Weight; Braun #125.

### **4. All Seats**

Seats shall be individually contoured to each passenger for occupant comfort and retention. Seats shall be covered with cloth-type woven fabric or vinyl fabric at the transit agency's option. Cloth-type fabric or vinyl shall completely enclose the seat cushion and the seat back. Cloth-type fabric or vinyl shall comply with test and performance criteria of the Federal Register dated October 20, 1993 (see Section IX., table 1). Seat colors shall be a tan background or grey background approved by the State.

- a. **Cloth-type Woven Fabric Requirements** (with flame resistant qualities)
  - (1) Minimum weight 23 ounces per linear yard.

- (2) 50,000 minimum double rubs (ASTM - 3597-77 Wyzewbeek Method).
- (3) Color fastness to light 300 hours minimum (AATCC-16-1977 Carbon Arc.)
- (4) Comply with cloth-type woven fabric seat material test and performance criteria of the Federal Register dated October 20, 1993 (see Section IX., table 1).
- (5) Comply with California BLT-117.
- (6) All cloth-type woven fabrics except Holdsworth Wool shall be treated with a flame proofing solution following the manufacturer's specifications, No-Flame by Amalgamated Chemical Inc.
- (7) Suggested sources: Flame Resistant Fabrics by Holdsworth Wool, or LaFrance Mills.

**b. Vinyl Fabric**

- (1) Seat vinyl fabric shall be transportation grade expanded vinyl, 36 ounces per linear yard minimum.
- (2) Seat vinyl fabric shall comply with test and performance criteria of the Federal Register dated October 20, 1993 (see Section IX., table 1).
- (3) Suggested source: Flame Resistant vinyl by CMI D-90 or Omnova .

**c. Seats General**

- (1) Seat cushion and back cushion shall be molded high resilient (HR) polyurethane foam padding. Seat cushion indentation load deflection (ILD) shall be 35 pounds minimum, with compression to 15 percent maximum, and tensile-strength of 15 minimum. Seat and back cushion shall meet the physical properties of ASTM D-3574 and the flammability requirements of FMVSS 302, minimum. The technical data sheet for the foam supplied shall be included in the bid proposal with the seat information. Suggested source: Manufacturer's standard.
- (2) The seating arrangements and configuration shall be furnished by the State. The first double seat on the passenger side of the bus shall have an integrated child restraint seat capable of safely carrying children of 20 to 50 pounds.
- (3) All seats shall be supported on the floor with high carbon steel support brackets. Seat frame shall be cold-roll steel tubing. Floor anchorage shall be neat and not interfere with entering and exiting the seat. All seat mounting bolts shall be corrosion resistant coated/plated fasteners. Passenger seating floor rail/track shall not be installed in the wheelchair

lift or wheelchair securement areas. The bidders shall provide certification test data that the installation of the seats, seat mountings including floor anchorage and floor fasteners shall meet all applicable FMVSS including FMVSS 207, 208, 209, and 210 for the bus model being offered in this bid. (see Section VIII. N.).

- (4) Seat and back cushions shall be supported with a spring-type support system. Seat and back cushions shall be completely covered with seat cushion covering material. Seat back depth shall not exceed 3½" overall.
- (5) All metal components of the seat assembly shall be coated with a powder coat epoxy paint finish that shall meet the following tests:

Salt Spray	1000 hrs	ASTM B117
Humidity Resistance	1000 hrs	ASTM D2247
Impact Resistance	to 80 in-lbs	ASTM D2794

All testing is to be performed on standard metal seating materials that have coating thickness of 1.3 to 1.8 mils. Certified test documents are required with bid proposal.

## **5. Passenger Seat Belts**

The bidders shall provide certification test data that the seat belts, and the installation are in compliance with FMVSS-207, 208, 209, and 210 where applicable for the bus model being offered in this bid (see Section VIII. N.).

Two universal "Buckle Up" decals approximately 6" by 6" shall be furnished loose with each bus. Decals shall indicate that seat belt use is recommended.

All seats shall be equipped with seat belts for each designated seating position. Belts shall be supplied by the seat manufacturer and have:

- a. An emergency locking retractor secured to the seat frame or bus structure. The retractor shall be part of the latch end of the belt. Final locations shall be determined at pilot model production.
- b. A push button latch release mechanism.

## **Q. Handrails, Stanchions (Shall meet ADA regulations)**

- 1. The handrails and stanchions shall be a minimum of 1¼" outside diameter. All handrails and stanchions shall be positioned so as not to interfere with wheelchair movement and shall meet ADA requirements for position and size. All handrails and stanchions in the passenger entrance area shall be highly visible yellow in color. All other handrails and stanchions shall be brushed stainless steel. Mounting brackets and fittings shall be composed of the same kind of material used for the stanchion or handrail.
- 2. All handrail and stanchion mountings shall have reinforcement plates welded to or imbedded in the structure behind surface panels of sufficient size and strength. Final locations shall be determined at pilot model inspection.

3. A floor-to-ceiling vertical stanchion shall be provided in close proximity to the rear of the driver's area. A guardrail shall be provided in back of the driver's area extending from the vertical stanchion to the left side of the bus 30" plus or minus 2" above the floor. A padded modesty panel shall be provided from the guardrail to within 8" of the floor. Stanchion and guardrail shall not restrict any driver's seat adjustments.
4. A smoked plexiglass panel, 3/8" thick, shall be provided behind driver from top of the driver's seat to within 12" of bus ceiling. The panel shall not impair driver's seat adjustments. The panel shall be located to allow the driver's seat back to recline to ½ its maximum reclined adjustment with the driver's seat in the position furthest from the steering wheel. Panel may be incorporated into the stanchion and guardrail behind the driver and shall have cutouts to give hand access to the vertical stanchion.
5. Floor-to-ceiling stanchions (yellow) shall be provided near aisle on each side of front entrance.
6. Left and right side entrance handrails (yellow) shall be installed from low stepwell to floor-to-ceiling stanchions near aisle. Entrance handrails shall be positioned so passengers entering or exiting the bus will have handrail support throughout the entering/exiting process and so that articles of clothing may not become entangled in the handrail-stanchion-guardrail assemblies.
7. A guardrail (yellow) shall be provided in front of and at the rear of the front entrance steps, extending from the vertical stanchions to the right side of the bus 30" plus or minus 2" above the floor. A modesty panel (padded both sides, vinyl clad) shall be provided to the left (rear side) of the entrance from guardrail to floor (in case of lift bus, provide floor-to-ceiling stanchion with guardrail and modesty panel to rear of platform lift).

## **R. Interior Lighting**

1. Overhead entrance and stepwell lights shall be LED and provide no less than two foot-candles of illumination on the entrance step tread, or lift or ramp with the door open. Outside light(s) shall provide at least 1 foot-candle of illumination on the street surface within 3 feet of step tread outer edge. This system shall provide illumination automatically when the door is open and meet ADA requirements.
2. Overhead entrance and stepwell lights shall be wired to and be automatically activated by a door controlled switch. Lights shall operate any time the ignition key is on and the door is opened.
3. Stepwell light shall be on the side away from wheel splash.
4. Interior lighting shall be LED and provide a minimum of two foot-candles of illumination at a reading level. Interior lighting fixtures shall be reasonably flush with the interior walls and ceiling so no hazard exists for the passengers. All lights shall have lead wire long enough to remove light at least 6" from bus for service. All interior lights shall be grounded by an in-harness ground attached in the fuse panel to a common grounding point.
5. Light installation shall be designed to illuminate the lift platform when deployed at floor level at no less than two foot-candles of illumination. Outside light(s) shall provide at

least 1 foot-candle of illumination on the street surface within 3 feet of step tread outer edge. This system shall provide illumination automatically when the lift door is open and meet ADA requirements. On-off light switch shall be lift door-actuated.

## **S. Exterior Lighting**

1. Exterior lighting shall be in accordance with Federal Motor Carrier Safety Regulations (393.11) and ADA regulations. All lights shall have the lead wires long enough to remove the light at least 6" from bus for service. All exterior lights shall be grounded by an in-harness ground attached in the fuse panel to a common grounding point. All exterior lights of the bus shall be light emitting diodes (LED) sealed lamps retained in a rubber grommet mounting except for front headlamp/turn signal assemblies. All lights shall have the mounting to body sealed to prevent moisture intrusion and grounded to the frame.
2. All lights in the rear panel of the bus shall be rubber grommet mounted round LED sealed lamps except the license plate light. License plate LED shall be Peterson Model M153C-MV with Peterson Model 150-40 bracket for those not mounted in the preformed recess in the rear panel. A sealed light with a weather proof connector shall be used when the preformed recess in the rear panel is used. Suggested Sources: Dialight, Peterson, Truck-Lite
3. Exterior marker lights shall be light emitting diodes (LED) (2" in diameter sealed lamp) retained in a rubber grommet mounting and conform to Federal Motor Carrier Safety Regulations Part 393. All marker lights shall have a weather proof two prong (one positive and one ground) plug-style connector with the ground wire connected to an in-harness ground attached to a common grounding point. Marker and tail lights shall be operated through a relay controlled by the headlight switch. Suggested Sources: Dialight lamp, Optronics, Peterson Lamp, Trucklite
4. Red voltage regulated LED high mount stop lamps shall be mounted centrally in the rear panel of the bus and work in conjunction with the brake lights. On buses with a rear emergency exit door, a 6½"x 2¼" oval light shall be mounted between the upper and lower windows on the exit door and a 4" round light shall be mounted on the rear of the bus body just above the rear door. On buses with a rear emergency exit window, the two 4" round lights shall be mounted on the rear of the bus body with one just below and one just above the rear emergency exit window. Final location of high mount stop lamps shall be determined at pilot model production. Suggested Sources: Command Electronics model 003-82, Dialight, Grote, Optronics, Peterson, Truck-Lite.
5. Brake lights shall be red 4" round sealed voltage regulated LED lamps and shall not override hazard flashers or turn signals. Rear turn signal lamps shall be amber 4" round sealed voltage regulated LED lamps.
6. Headlights shall be Halogen lamps and the standard front park/turn lights may be a part of the OEM headlight assembly.
7. License plate mounting shall be with stainless steel screws and jack nut for securing license plate. Suggested Source: Wm. F. Hurst Co. model 6SJN

## **T. Safety Equipment**

All safety equipment provided by the manufacturer shall be secured to each bus and be easily accessible to the driver. Location of safety equipment shall be determined at pilot model production. The safety equipment shall be:

1. One UL listed 5 pound, 2A-10BC dry chemical fire extinguisher. Fire extinguisher shall have a metal head, a gauge to indicate state of charge, and a bracket with strap for securement. Source: Manufacturer's Standard.
2. One container of bi-directional emergency reflective triangles that meets FMVSS 125.

## **U. Heating/Ventilating/Air Conditioning (HVAC)**

1. During normal passenger service, front and rear heavy-duty heating system shall be capable of raising the interior temperature of a bus from 0°F to 60°F at knee level (22" above the floor) throughout the interior of bus within 30 minutes from engine startup. After initial warm-up, while the bus is in passenger service, the front and rear heavy-duty heating system shall be sufficient to maintain a minimum of 64°F at knee level throughout interior of bus and at the driver's foot space when the outside temperature is 0°F. Heating system operation will be verified by the required system testing as defined in Section VII Part D. Heating/Ventilating (HV) Certification. In addition to the front heater and windshield defrosters, for increased air circulation, one 6" two speed fan with non-glare blades and body shall be mounted away from passenger and driver traffic in the driver's area near the windshield. The fan shall be mounted securely with nuts, bolts, and washers. Grounding for all heater fan motors shall be supplied by an in harness ground wire attached in the fuse panel to a common grounding point. All HVAC fan motors shall be supplied with proper radio frequency (RF) suppression equipment to remove two-way radio interference.
2. Front heating unit shall be automotive in-dash type, chassis Original Equipment Manufacturer (OEM), and shall be capable of delivering heat, fresh air ventilation, and air conditioning (optional) to the driver's area. The front heater shall have a temperature control valve which can be regulated from the driver's area. The driver's area shall have air circulation in each mode of defrost, heat, fresh air ventilation, and air conditioning (optional) of 125 cfm at the foot area, with a total driver's area circulation of 400 cfm minimum.
3. Rear heating unit(s) shall distribute heat in at least a 180° direction and ensure air distribution to all passenger areas of the bus interior. Heating unit(s) shall have a minimum ¾" I.D. heater inlet and outlet ports with a BTU/hr output rating to match the specified HVAC performance requirements. Coolant flow through the heating units shall not be restricted by excessive bends or kinks in hoses or excessive lengths of hoses. Heating units shall have rubber or nylon insulator(s) between their mounting base and floor of the bus. Suggested sources: AMFAB Inc., A. R. Lintern, Bergstrom, Pro-Air.
4. The premium heater hose (¾" ID minimum) shall be high temperature resistant Ethylene Propylene Diene Monomer (EPDM) material. Hose shall be a reinforced type with Aramid knitted fiber reinforcement between the EPDM tube and EPDM cover. Heater hose material shall be compatible with all types of coolant including long life coolant. Rated temperature limits of the hose shall be -40°F to +300°F minimum, with a burst pressure of 130 PSI minimum.

5. Manual shut off valves for the rear heater shall be placed as close to the engine as is practical. The 3/4" ID heavy-duty brass 1/4 turn ball shut off valves shall be located in the heater outlet line (from engine to heater) and in the heater inlet line (to engine from heater). Shut off valves shall be accessible by personnel without going under the bus. Location to be determined at pilot model inspection.
6. Front heater shall have coolant temperature control valve or other controls which can regulate heater temperature from the driver's area.
7. All heat lines and hoses shall: have exterior routing along the bus frame rail where possible; be sufficiently protected to ensure against wear from friction and the elements; be insulated to reduce heat loss; use routing that eliminates excessive bends and hose lengths; and have heater hose passage holes through engine cowl and floor area thoroughly sealed to prevent air, dust, and moisture intrusion.
8. Air Conditioning (see Alternate Quotes, Section VI. A).

## **V. Windows**

1. Passenger compartment windows shall be T-type slider at top, full slider, or top tip-in type for window ventilation. Windows shall have double-density safety glass and heavy-duty locking features which shall meet FMVSS 217 for emergency exits, if applicable. Window glazing material shall be able to maintain its seal and glass retention for the life of the unit. Caulking around windows shall be used only as a seal, not to make up for body defects or out of tolerance window openings (maximum clearance of 1/4" around the frame, 1/8" on each side). All window glass shall be tinted – passenger windows AS-3 tint 31% luminous transmittance, right and left driver's side windows AS-2 tint 70% luminous transmittance, and windshield shaded-tinted AS-1 tint – and meet applicable federal standards. Driver's compartment right and left side windows shall be designed for maximum window area to provide unobstructed vision. Driver's compartment left side window shall be adjustable vent type (moveable front section of lower portion for ventilation) or chassis Original Equipment Manufacturer (OEM) door window. Driver's right side window shall be one piece. Suggested sources: Hehr, Kinro, Sampers.

## **W. Paint**

1. All exterior surfaces shall be smooth and free of visible fasteners (excluding round head structural rivets), dents, and wrinkles. As appropriate for the paint used and prior to application of paint, the exterior surfaces to be painted shall be properly cleaned and primed to assure a proper bond between the substrate and successive coats of original paint. Paint shall be applied smoothly and evenly, with the finished surface free of dirt, runs, orange peel, and other imperfections. All exterior finished surfaces shall be impervious to diesel fuel, gasoline, and commercial cleaning agents. Finished surfaces shall not be damaged by controlled applications of commonly used graffiti-removing chemicals.
2. All exterior paint shall be a two part acrylic-urethane-type or polyurethane-type with low volatile organic compound (VOC) emission. The finish coat of paint shall be applied before rubrail covers or inserts, fender flares, exterior lights, and other body mounted accessories are installed. Paint shall be applied in the following method:

- a. If on bare aluminum, use proper cleaner. Recommended sources: DuPont 2253, PPG followed by aluminum conversion. Recommend sources: DuPont 2265, PPG.
  - b. If on bare steel, use proper cleaner. Recommended sources: DuPont 5717S, PPG followed with steel conversion.
  - c. For all bare metal, use primer. Recommended sources: DuPont Prime 615/616 (two coats), PPG.
  - d. Appropriate primer as required shall be used on fiberglass surfaces.
  - e. Coat entire prepared surface to be painted with minimum of two coats of paint properly activated and reduced and have a minimum thickness of three millimeters. Recommended sources: DuPont, PPG Concept System, Sikkens Corporation U-Tech brand.
3. Standard paint color for all buses shall be the manufacturer's pre-finished white exterior panels (OEM white). Color scheme on all buses shall be provided at the time of ordering. Additional paint schemes will be quoted in VI. ALTERNATE QUOTES (OPTIONS) Item K. Special design paint application pricing will be negotiated at the time of ordering by the transit agency.

#### **X. Insulation**

1. Inside walls, ceiling, passenger floor area, driver floor area, and fire wall area shall be adequately insulated for sub-zero winters with spray-type foam insulation or glued in place insulation with a minimum R factor of 5. The insulation shall be non-formaldehyde, fire-resistant (FMVSS 302 minimum), non-hygroscopic, and resistant to fungus. Insulation shall prevent condensation and thoroughly seal bus so that drafts cannot be felt by the driver or passengers during operations with the passenger door closed. Insulation shall not cover up electrical wiring harnesses, electrical switches, or other devices and shall not be sprayed in wheelwells. All mechanisms (moving or stationary parts) that are affected, create a fire hazard, or are rendered useless by an application of sealant or insulation shall be cleaned free of sealant or insulation, including vent canisters and drain pipes.
2. Engine hood cover and driver's area shall have adequate insulation to keep driver's foot area cool during summer months, warm during winter months, and reduce engine noise to an acceptable level.

#### **Y. Type I Lift, Passive (Platform Type) (Shall Meet ADA Requirements)**

1. The Type I platform lift (passive lift) shall be installed in a separate door opening for use by persons with disabilities. The lift assembly shall be mounted within the bus body on the right (curb) side. The bus manufacturer must provide documentation (reviewed by the State at pilot model production) that the lift installation complies with the lift manufacturer's lift installation requirements. The overhead clearance between the top of the door opening and the raised lift platform, or highest point of a ramp shall be a minimum of 68" for a bus over 22 feet in length to meet ADA requirements.

2. The lift door(s) shall be manually operated with an outside key locking handle. Spring loaded struts, gas struts or manual latches shall be provided on the lift door(s) to positively hold the door(s) in the open position. All door openings shall have full structural framing around the opening equal to the structural members of the body. The lift door(s) shall have an upper window similar to the side windows of the bus. Any exposed lift door frame structure shall be constructed of 304 stainless steel, a grade which does not discolor with aging.
3. The lift shall be an electro-hydraulic type. If the lift has a crossbar, it shall be above the door opening and well padded. The platform lift equipment shall be a double "C" channel parallel arm construction, hydraulically operated by two single-acting cylinders with gravity unfold, gravity down, power up, and power fold (stow) operation. No part of the lift platform shall exceed 6 inches/second during the lowering and lifting of an occupant, and shall not exceed 12 inches/second during deploying or stowing. The lift shall have a mechanical outboard safety wheel stop to prevent wheelchair from rolling off the platform during the lifting cycle. Successful bidder shall deliver the lift equipped bus with the type of lift equipment requested by the State. Suggested sources: Braun, Maxon, Ricon.
4. A manual safety override shall be provided that will remain operable. Lift shall have manual override instructions visible from inside and outside the bus with door open.
5. The entire lift assembly shall be installed inside the bus body and shall have adequate protection installed on all sharp corners or items that protrude into the passenger area to prevent accidental injury to passengers. Wall and floor mounting points shall be reinforced and shall be attached with fasteners having a thread locking feature. Lift installation shall insure that no lift rattling exists when the bus is operated while the lift is stowed.
6. A lift control interlock system shall be installed that shall ensure that the bus cannot be moved when the lift is not stowed and that the lift cannot be deployed unless the interlock is engaged [to meet ADA regulation in 49 CFR Part 38, Subpart B-Buses, Vans and Systems, §38.23, (b)(2)(I)]. The interlock system shall engage when the lift operation sequence is followed. Interlock operating instructions shall be included with the bus at delivery. An indicator light (red, labeled) shall be provided at the driver's station that is activated when the lift door is open and when the lift is in operation. An interlock override system shall be installed that allows service personnel to move the bus to a safe area for repairs. Suggested Source: Intelligent Lift Interlock System (ILIS) by Intermotive Products
7. All lift equipped buses shall display the international symbol of accessibility, one each on left and right side of the bus. Location shall be determined at pilot model inspection.
8. The passive lift shall meet ADA requirements as well as these minimum requirements.
  - a. Capacity 800 pounds minimum.
  - b. Usable platform width 33" minimum.
  - c. Usable platform length 50" minimum.

- d. Platform shall include automatic locking inboard safety wheel stop (minimum 6" height) and outboard safety wheel stops to prevent wheelchair from rolling off.
- e. Platform shall automatically stop at floor level.
- f. Platform shall automatically stop when lowered to ground level.
- g. Hand held controls shall be conveniently located on a flexible or coiled, cut-resistant cable and shall be mounted with access from inside or outside the bus. The cable shall be routed to eliminate being pinched in any moving parts and be wrapped with a flexible exterior protective conduit.
- h. Platform, bridge plate, and area between bridge plate and aisle shall be skid resistant.
- i. Bridge plate and platform shall be coated to resist rust.
- j. Platform shall have horizontal handrails (one each side) on platform to assist passenger during lift operations. Handrails (yellow) shall fold automatically to prevent any obstructions into the bus passenger area.
- k. Lift door operated interrupt switch shall prevent use of lift with lift door(s) closed. Heavy duty long life switches shall be used in this application.
- l. The color of the lift shall coordinate with bus interior colors and be approved by the State. The outside edges of the platform shall either be painted yellow or use 3M™ vinyl safety stripe tape to enhance visibility when extended on the ground.
- m. Sharp corners of lift platform shall be padded (remove for lift use) when in the stored position.
- n. The wheelchair lift shall comply with all federal, Americans with Disabilities Act (ADA), and Veterans' Administration regulations.
- o. Lift platform shall be fitted with device to prevent the platform from touching or leaning against door after being returned to stored position when the lift assembly is not in use.

### **III. WHEELCHAIR SECUREMENT AREA**

- A. The wheelchair securement system shall be installed according to ADA requirements. Securement location shall be installed as shown by the seating plan option and approved at pilot model production. Fold-away seating shall be provided for use when wheelchairs are not being carried as shown in floor plans. The integrated securement system shall restrain the occupant and the wheelchair separately and securely.
- B. Wheelchair securement shall meet these minimum requirements:
  - 1. Forward facing wheelchair tie down and occupant restraint shall consist of four floor attachment points for the chair and a combination, lap belt/shoulder restraint with manual height adjuster for the occupant per location.

2. Securement floor anchorage points shall be anodized aluminum, stainless steel or other noncorrosive metal construction and consist of aircraft type insert pockets that can be flush mounted with the rubber flooring (Flanged "L" style track with end caps Q-Straint Q5-6100-FPD). Floor anchorage points for the first securement space shall be spaced at a minimum of 54" from front to rear. Floor anchorage points shall be located no closer than 8" from a stationary wall or obstruction (forward or rearward) that would hinder an operator from attaching the securement system. Anchorage points can be used for the front tie downs, the rear tie downs, and can be shared by the center run of anchorage track. Width of anchorage track shall be no less than 30" wide allowing for the widest of mobility devices.
3. Securement wall anchorage point for shoulder restraint shall be stainless steel or other aircraft quality noncorrosive metal. Wall anchorage device shall provide vertical adjustment (approximately 12") for differences in height of the secured mobility aid. Wall anchor shall be permanently fastened to the body structure in the wall according to the belt assembly manufacturer's installation instructions.
4. The four belts that attach to the wheelchair from the floor anchorage points shall use a simple speed hook end ("J" or "S" style) for chair attachment and have automatic heavy duty retractors with a hard metal cover and manual knob control. All floor attachment belts shall be the same and work in any of the four floor attachment points and be equipped with connector brackets for the lap belt assembly. Automatic self tensioning and self locking retractors with metal covers shall be part of the four floor belt assemblies for automatic belt tensioning. Belt ends with floor anchor attachments shall be easily identified for placement in the floor track.
5. All belt components shall meet ADA requirements and random static testing forces equal to:

rear belt assy.	6,000 lbs. each, minimum
front belt assy.	2,000 lbs. each, minimum
lap belt assy.	2,500 lbs. each, minimum
shoulder belt assy.	2,500 lbs. each, minimum
floor insert assy.	6,000 lbs. each, minimum
6. All components shall meet SAE J2249 requirements and be 30 MPH/20G impact tested.
7. All components shall be installed to the securement manufacturer's recommended specifications.
8. Suggested sources: Q'Straint Model Q-8100-A1L; Sure-Lok's Retraktor™ Systems for L track; Q'Straint Model Q-8100-A1L.

C. Storage pouches (one for each securement area) shall be provided for wheelchair restraints so that the restraints can be stored off the floor in the bus when not in use. Location of storage pouches will be determined by the state at pilot model inspection.

#### IV. CHASSIS SPECIFICATIONS

The chassis shall have a pre-delivery inspection performed by a representative of the chassis manufacturer before the bus manufacturing process begins. A copy of the completed pre-delivery

inspection form shall accompany the bare chassis and accompany the bus during manufacture as part of the build order. All standard or optional chassis equipment to be included shall be as advertised by the manufacturer and factory installed and shall not consist of substitute or after market equipment. Optional chassis equipment not available from the factory may be dealer installed. The chassis shall meet the following minimum requirements.

#### **A. Chassis**

Chassis shall be the heaviest available for wheelbase, designed for transit use with straight channel side rails of 50,000 pounds per square inch (PSI) minimum yield strength steel. Chassis shall have one front axle (I-beam) with single wheels and one rear axle (full floating) with dual wheels. Front axle shall have kingpins with adjustable tapered roller bearings (upper) and front axle shall be mounted for sharp steering angle (minimum lock angle of 48°). **Note:** Axles (front and rear) shall be equipped with axle oil seals (Stemco, Chicago Rawhide, or equal), shall be filled with proper lubricating oil, and front hubs shall include fill plugs and fluid level windows.

#### **B. Tilt Wheel/Power Steering**

Chassis shall be equipped with power steering and a tilt wheel steering column. The steering column shall be adjustable for various up and down positions of the steering wheel. The steering gear shall be a full hydraulic power assist type.

#### **C. Wheelbase**

The desired wheelbase range shall be 195" to 217" using the wheelbase for each of the specified bus lengths which will provide proper approach and departure angles, proper handling, and proper ride characteristics. Maximum rear overhang shall not exceed 1 / 3 bus overall length.

#### **D. Engine, Diesel**

1. The electronically controlled engine shall be either an in-line 6 cylinder turbocharged diesel engine 5.9 litre minimum, 195 gross horse power at 2,600 revolutions per minute (RPM) with air-to-air after cooling or an 8 cylinder (V-8 OHV) turbocharged diesel engine 6.0 litre minimum, 195 gross horse power at 2300/2600 RPM with air-to-air intercooling. Acceptable engines include Caterpillar 3126, Cummings 5.9 ISB, General Motors Duramax 6600, and Navistar International Transportation Corp. VT-365, or equal. The diesel engine shall be equipped with a fuel/water separator unit with a dash indicator light, an automatic engine shutdown system (see Section V., part A., Item 6), and a water jacket block heater that is a 1000 watt 110- volt model. The electronic diesel engine shall meet current EPA low sulphur fuel and emissions standards for buses. Materials for cylinder head and valves and other internal engine parts shall be compatible for use when ultra low sulfur fuel is available. Driver's area noise level (at driver ear level) shall not exceed 82 DBA at a constant speed of 55 mph on a level roadway and shall be verified at pilot model production.
2. Auxiliary Coolant Heater
  - a) All buses with diesel engines shall be equipped with an auxiliary heater system that shall be able to preheat, provide supplemental heat, and maintain heat for the engine and the interior of the bus. The auxiliary heater system shall be supplied in heated coolant model for diesel engines. The heater system shall be complete with all fuel and electrical controls, exhaust system, and standard warranty. All auxiliary heaters shall be 12-volt units with a fused power supply and with

protection for high and low voltage conditions. The auxiliary heater system shall meet FMVSS 301 fuel system integrity requirements. The heating units shall be fueled from the bus's primary fuel supply. The auxiliary heating units shall be connected electrically to run whenever the bus's rear heat exchanger fan is turned on. The on/off seven day programmable modular electronic timer controls for the heating units shall be located in the driver's area of each bus. The seven-day timer control shall be capable of a two hour preheat control, minimum, and be capable of continuous run control when the key is on with the engine running. The electrical connection shall be a one piece harness from the control switch to the heating unit with all exterior connections Weather-Pak. Location shall be determined at the Pre-Pilot Model Review Meeting.

- b) The heated coolant model shall be a self-contained unit mounted under the bus near the rear heating unit, and connected to the heater hoses leading to the rear heating unit. The auxiliary heating unit inlet and outlet hoses shall have ¾" ID heavy-duty brass ¼ turn ball valves for shut off when the heater needs to be removed for servicing. It shall be in an enclosure supplied by the auxiliary heater manufacturer, be installed so that adequate ground clearance exists below the heater enclosure box, be easily accessible for servicing, be weather resistant, and be complete with mounting brackets/hardware and coolant circulator pump. The coolant circulator pump shall provide a minimum flow of 3.5 gallons per minute. The heated coolant system units shall have safety features for temperature regulating and overheat shut down switches. A seven day digital timer shall be used to control operation. The auxiliary heater exhaust shall exit just below the heater enclosure toward the rear of the bus or at the side of the bus. The coolant heater shall control coolant temperature between a low of 154°F and a high of 185°F. Coolant heater output shall operate automatically at different levels with a high heat output of 25,500 BTU/hr minimum (boost setting may be higher). Suggested sources: Espar Inc., Hydronic 10 (diesel, heated coolant), Webasto Thermo 90S (diesel, heated coolant).

#### **E. Transmission**

The electronically controlled transmission shall be a heavy-duty, five-speed automatic cooled by an external "H.D. transmission oil cooler" in series with radiator cooler or equal (cooler capacity to match GVWR of bus). The transmission shall have an external spin-on type filter. Suggested source: Allison Transmission 1000 or 2000 series matched to the electronic engine and chassis.

#### **F. Alignment**

The bus shall have a four wheel alignment at final point of inspection, just prior to delivery to the transit agency. A copy of the work order indicating the camber, caster and toe-in settings at time of final inspection shall be provided with the bus at delivery.

#### **G. Gross Bus Weight Rating (GVWR)**

**I-Beam Front Axle Rating - 8,000-lb. minimum.** Bus axle weight shall not exceed chassis manufacturer's front axle weight rating or spring and tire capacity.

**Rear Axle Rating, - 15,000-lb. minimum.** Bus axle weight shall not exceed chassis manufacturer's rear axle weight rating or spring and tire capacity.

**Chassis GVWR - 22,000-lb. minimum.** (see Purpose of Specifications Section I.) Engineering calculated loaded bus axle weight charts are required with the bid.

#### **H. Differential**

Heavy-duty rear axle with full floating axles. Gear ratio shall allow buses to travel approximately 65 miles m.p.h. loaded, and not exceed manufacturer's recommended engine operating R.P.M. Axles shall be marked if synthetic oil is used.

#### **I. Battery**

The battery equipment shall be furnished by the chassis manufacturer where available. The dual batteries shall be maintenance free with reserve capacity of 400 minutes @ 80°F, CCA-1250, 12-volt minimum (dual Delco Group 31-1150 series). The batteries installed in the bus must be a pair of matching units. The batteries must be fresh, fully charged units when the finished bus leaves the manufacturing plant. Batteries that have been in the bus during the manufacturing process which were allowed to become fully discharged for a period of time shall be replaced with fresh new batteries. Where there is no permanent OEM mounting enclosure and securement, the batteries shall be mounted on a slide-out stainless steel tray with battery hold down secured with bolts. The slide-out tray shall be mounted on properly supported mechanism with grease fittings, all of which shall have adequate capacity to support the battery equipment. The battery slide-out tray shall allow movement to permit full service of batteries outside of the bus body. The inside of the battery compartment shall be covered with a durable insulating material to prevent electrical shorts. The totally enclosed battery compartment shall be vented and the tray shall be coated with an acid resistant coating. The battery compartment must be located below the floor line with adequate reinforcement brackets mounted to floor supports. The battery compartment shall be fitted with an insulated standard exterior access door with hinge and flush pull-style latch(es) (SouthCo Model #M1-61-1), which match latches on other compartment access doors. The battery box compartment must be marked to say "battery inside".

#### **J. Battery Cables and Grounds**

Battery positive and ground cables shall be AWG size 2/0 minimum, fine stranded, flexible copper wire with permanently affixed cable connector ends with heat shrink tubing applied. All cable ends shall be fastened in a manner equal to the method used by the chassis Original Equipment Manufacturer (OEM). Positive cable ends at the battery shall use a protective cover or cap as an added insulator. Cable assemblies installed in place of chassis manufacturer's battery cables shall be sized to match the electrical system's maximum current draw to provide proper engine starting and operation of all systems.

An additional ground of the battery cable size shall be installed between the engine and chassis frame and between the transmission case and the chassis frame. One additional ground wire of the battery cable size shall be installed between the frame rails just ahead of the rear axle. The bus body shall be properly grounded with cables to the chassis frame in at least two places. Engine, body, and equipment grounds (properly sized) shall be installed to handle subsystem electrical capacity. Lift pump motor shall be grounded directly to chassis frame using a cable of the same size as the pump motor feed wire. All exterior lights and accessories added by the body manufacturer shall be grounded by an in-harness ground attached at a common grounding point. There may be a common grounding point in the rear of the bus along with a required grounding point at the fuse panel. For all ground wire connections; 1) paint shall be removed at the grounding point to provide a cleaned surface; 2) grounding wires and cables fastened to the

frame or body structure shall use a bolt with nut installed in a proper sized hole; and 3) a coating of dielectric material shall be applied to the cleaned surfaces, cable ends, bolts, and nuts where each positive or grounding cable or wire is attached.

All buses shall be supplied with proper radio frequency (RF) suppression equipment to reduce radio interference and improve radio transmission and reception performance. High corrosion resistance and high conductivity braided ground straps shall be added: between the engine and the chassis frame of 1" width, minimum; between the engine and the firewall of ½" width, minimum; two between the frame and the body sections of ½" width, minimum; and between the separate body sections of ½" width, minimum. For all braided ground wire connections, paint shall be removed and a coating of dielectric material applied to the cleaned surfaces where each braided cable attaches as is required in other ground wire applications. All removable covers in the engine area including fiberglass hoods need to be shielded and RF grounded. All braided high corrosion resistance and high conductivity ground straps shall be as short as possible and shall use the negative battery cable attachment point (except those between separate body sections) as the termination point of the RF grounding.

#### **K. Alternator**

The alternator equipment shall be furnished by the chassis manufacturer where high output will match system needs. This dual system shall be a 12-volt serpentine belt drive with internal or external voltage regulator. It shall be capable of maintaining the battery at a state of full charge under all operating conditions and equipment loads, 200 amp minimum. The alternator(s) shall be supplied with proper radio frequency (RF) suppression equipment and have a ½" wide braided ground strap connected between the alternator frame and the engine block to reduce two-way radio interference. Any bracket modifications shall not reduce the strength of the mounting bracket. Chassis alternator equipment available that is unable to meet electrical needs may be replaced by Leece-Neville, PennTex that will meet system needs. Any non-Original Equipment Manufacturer (OEM) alternator equipment installed on a bus by the body manufacturer shall be covered by a minimum warranty period equal to the chassis OEM alternator warranty. It is the responsibility of the manufacturer (bus supplier) to match the alternator performance to the bus's electrical system needs.

#### **L. Engine Fast Idle**

The engine shall be equipped with fast idle control which includes manual and automatic control features. Fast idle shall not activate unless parking brake is set and transmission control is in neutral (N) or park (P). The control system shall have a manual switch, volt sensor, an indicator light, and activate automatically from voltage sensors. The system shall automatically deactivate when bus is shifted into gear and when the bus foundation brakes are applied. Suggested source: Chassis manufacturer's equipment, Advanced Fast Idle System (AFIS) by Intermotive Products, PennTex Model PX-HI-(mod no) with time out module, Vortec MD30-2500.

#### **M. Brakes**

Foundation brakes shall be a power-actuated hydraulic split system of a four wheel disc type with a four channel anti-lock braking system. The system shall be the heaviest-duty available for stop and go operation. The brake system shall include a red brake warning lamp (RBWL) in the instrument cluster that lights when the parking brake is on, when a front or rear hydraulic failure occurs, or when brake fluid is low in the reservoir and act as a low brake warning system.

1. Foundation front brakes -- Minimum 14.75" x 1.34" disc rotor with dust covers with a minimum of 74 square inches pad lining.
2. Foundation rear brakes -- Minimum 14.75" x 1.34" disc rotor with dust covers with a minimum of 74 square inches pad lining.
3. A parking brake (driveline mounted expanding shoe type) shall be rebuildable and the heaviest-duty available from the chassis manufacturer.

#### **N. Fuel Tank**

Fuel tank capacity shall be a minimum of 60 gallons for all buses. Fuel fill shall not extend beyond the exterior surface of the bus and may have the fuel cap set in a recess similar to a Ford OEM unit. Fuel fill shall be on the street (left) side of the bus.

#### **O. Hazard Flashers**

Hazard flashers shall use the OEM switch and control system with an electronic flasher.

#### **P. Shock Absorbers**

Chassis shall have gas filled shock absorbers front and rear, most heavy-duty available from chassis manufacturer.

#### **Q. Springs/Suspension**

1. The chassis shall be equipped with a heavy-duty tapered leaf (parabolic) spring front suspension to match the specified gross axle weight rating.
2. The chassis shall be equipped with a heavy-duty rear suspension fitted with a rubber shear spring suspension that works in conjunction with the OEM chassis leaf spring suspension to match the specified gross axle weight rating. The added suspension that replaces the air ride suspension consists of a spring carrier assembly, a frame hanger assembly, a cross-member tube assembly, and a carrier spring assembly, shall be installed in place of the original spring hanger and shackle assembly. The frame hanger must bolt into the existing Original Equipment Manufacturer (OEM) spring hanger holes in the frame. The added suspension system must not alter the OEM gross axle weight rating. MOR/ryde® "RL" Suspension System.

#### **R. Stabilizer**

Chassis shall have heavy-duty OEM suspension stabilizers.

#### **S. Wheels**

Bus wheels (6) shall be 19.5" x 6.75" minimum, steel disc, hub piloted type, 8-hole flange nut style. Wheels shall have all stainless steel or all brass valve stems a minimum of 1½" in length retained by threaded nuts fitted with stainless steel, steel or brass valve caps with an inner air seal. Wheels shall be OEM white.

#### **T. Tires**

All tires (6) shall be tubeless, steel radial blackwall, 245/70R19.5 F/12 ply rating minimum (to meet GVWR), single front, dual rear. The front tires shall be high miler or all season tubeless; dual rear tires shall be snow tread tubeless. Suggested sources: Goodyear, Michelin XZA, Unisteell.

#### **U. Drive Shaft**

The multi-piece drive shaft shall be OEM and have guards of sufficient strength to prevent any drive shaft section from striking the floor of the bus or the ground in the event of a tube or universal joint failure. Drive shaft guards, (OEM chassis equipment preferred, or may installed by the chassis manufacturer) shall be secured properly and be equal in materials and design to drive shaft guarding installed on a school bus chassis.

#### **V. Wipers/Horn**

Electric wipers shall be two speed, delay style, dual jet washers (electric), with manufacturer's standard arms and blades (OEM equipment preferred). Wiper motors shall be mounted for easy access and not interfere with other equipment mounted in the front bulkhead/cowl of the bus. Where individual wiper motors are used (one for each side), each shall be supplied by its own fused feed wire. The bus shall have two electric horns.

#### **W. Radiator and Cooling System**

The cooling system shall have an extra cooling capacity radiator (aluminum or copper core), water pump, pulley, and clutch-type fan with coolant recovery system with a factory installed coolant filter (heavy duty system installed by chassis manufacturer). Cooling system shall be winterized with 50/50 mixture (minimum) of permanent antifreeze and distilled water or a factory premix (minimum -35°F freezing point). Radiator removal instructions and estimated removal time shall be furnished with first bus to each agency. Coolant integrity shall be maintained throughout the manufacturing process to insure that the coolant, including additives, in the delivered bus is equal to the coolant installed at the chassis OEM factory. All cooling system hose connections in the engine compartment shall use constant tension spring loaded band clamps (Breeze Constant-Torque<sup>®</sup>, Clampco Products Inc., Oetiker that automatically adjust for thermal expansion and contraction to control leakage.

#### **X. Fluids**

Fluids shall be checked and filled from inside front hood where application allows. Engine oil fill/check, transmission oil fill/check, and coolant fill/check shall be located for easy access.

#### **Y. Engine Cover**

The engine cover shall be insulated from engine heat, engine noise, and road noise. Additional equipment added to the engine cover area shall not interfere with removal/installation of the engine cover.

#### **Z. Exhaust System**

The exhaust shall exit the rear of the bus on the street (left) side flush with left end of the rear bumper. The exhaust system shall meet FMVSS §393.83 and current Environmental Protection

Agency (EPA) requirements. The exhaust system must be installed to provide maximum ground clearance and departure angle at the rear of the bus.

## V. OTHER ITEMS

### A. Safety Items

The following safety items shall be provided on each bus:

1. A 12-volt 97-db sealed solid state electronic warning alarm that is readily audible from outside the bus when transmission is in reverse. The alarm shall: be steam cleanable; have passed a 1 million cycle test; and meet SAE J994, OSHA, Bureau of Mines and all State Regulations. The alarm shall be mounted with bolts and properly grounded in a protected location in the rear axle area (location shall be approved by the State). Suggested source: OEM standard.
2. The rear door shall have an audible alarm at driver area that is energized when the rear door latch handle starts to open and when the rear door is locked with the ignition in the on or accessory position.
3. A lift master switch with light (green and labeled) at driver's station, illuminated when switch is on.
4. An indicator light (red and labeled) at driver's station that is activated when lift door is open and when the lift is in operation.
5. An interlock system shall be provided to ensure that the bus cannot be moved when the lift is not stowed and that the lift cannot be deployed unless the interlock is engaged (to meet ADA regulation). The interlock system shall engage when the lift operation sequence is followed. Interlock operating instructions shall be included with each bus at delivery.
6. A warning/engine shutdown system which shall be capable of monitoring oil pressure, engine temperature, and engine coolant level and which shall sound an alarm and shut down the engine when:
  - a. Low oil pressure occurs.
  - b. High coolant temperature occurs.
  - c. Low coolant level occurs.

The warning/engine shutdown system shall include an audible alarm (with warning light) and visual indicator lights (oil pressure, temperature, and the like) in the driver's area. The visual indicator lights shall be labeled to define the source of engine shutdown as a system diagnostic aid. The low coolant probe may be installed in the coolant surge tank but not in the coolant overflow/recovery container. Suggested sources: Chassis OEM, Murphy System.

7. An automatic daytime headlight control system shall be provided. The system shall illuminate the headlights when the ignition switch is on and the headlight switch is off. The system shall activate automatically after engine start up with the headlamp switch off and shall deactivate automatically when the headlamp switch is on or the ignition switch is turned off. Suggested source: Chassis OEM.

8. A low profile electronic strobe light (white) with a clear lens and branch guard shall be provided. The light shall meet SAE J1318 requirements and be mounted centrally on the roof of the bus approximately 6 feet forward of the rear of the bus. The 12 volt light shall have a control switch in the driver's area. The light shall be approximately 4" in height, produce 80 ( $\pm 10$ ) double flashes per minute, and have a light intensity of 1 million candlepower with a current draw of approximately 1 ampere. Suggested Sources: Meteorlite, Peterson, Target Tech Pulsator<sup>®</sup> 451, Truck-Lite

## **B. Electrical**

1. Lift equipped buses shall have a circuit breaker with a manual reset in the lift feed circuit. The circuit breaker shall be installed in the battery box, in the positive power cable leading to the lift power pack.
2. Install a 12 volt power point for hand held equipment in the driver's area.
3. All cable and wires added by the body manufacturer shall be continuous color coded and numbered or function coded. The manufacturer shall furnish complete as built wiring diagrams with integrated body and chassis wiring marked to show the codes used. Mating harnesses and harness connectors shall use matching wiring and coding unless chassis OEM wiring and coding is different from body manufacturer's. The wiring shall be designed to be a "plug and play" system where the harnesses and components are fastened through common standard terminal ends and connectors.
4. Electrical panels installed by the body builders shall be located for easy access. Circuit breaker circuit protection shall be standard but blade type fuses may be used when expressly required by the component manufacturer. The master electrical panel shall use a separate "plug and play" connector and terminal system. Highest quality components available shall be used. Two spare electrical fuses that match fuses used on the bus body and chassis shall be supplied with the bus and stored in a box or spare circuit area at fuse box. All components shall be placed on the front of the electrical panel for ease of service. Suggested sources: R.C. Tronics Incorporated
5. All wiring added to chassis fuse block shall be securely fastened to prevent wires from being knocked loose or loosening from vibration. The manufacturer shall use wire raceways where needed. Wiring, harnesses, and raceways shall be supported at regular intervals by "P" clamps, or by other supporting hangers where necessary, and routed in separate hangers from heater hoses or air conditioning hoses. Body fuse/electrical panel shall be sufficiently sealed to prevent intrusion of dirt and moisture.
6. All wiring shall be heavy-duty; be properly grounded to body frame structure and the chassis; use a common grounding point; and be adequate for electrical system capacity. All wiring passage holes through engine cowl, floor area, and other partitions shall be thoroughly sealed to prevent dust and moisture intrusion.
7. All accessories and accessory electrical equipment shall be wired through a constant solenoid energized when the bus's ignition switch is in "ignition on" or "run" mode. A master switch with light in the driver's control panel shall control this constant solenoid and act as a quiet switch overriding individual switches for accessories. This master

switch is wired in series with the ignition switch to control the constant solenoid. The constant solenoid shall not control headlights, taillights, emergency lights, charging system voltage regulator energizer lead, a fused power lead for the passenger door, and a fused constant power lead for all electronic control units' long term memory.

8. All control switches, relays, and circuit breakers used for the various electrical circuits shall have a current carrying capacity adequate for the circuit that they control and shall be properly marked for their function. The illuminated switch markings shall be permanent and not wear off with switch use. Control switches shall be positioned for easy access.
9. All added wiring shall be installed in a properly sized and supported split open-type loom or a properly supported raceway for protection. All wiring harnesses shall have adequate length to allow for harness flexing from supporting brackets and where harnesses connect to electrical equipment. Any wiring added by splicing into an existing chassis Original Equipment Manufacturer (OEM) harness or wire shall match modification standards set forth by the chassis manufacturer, such as Ford's QVM. Any added accessories or electrical circuits shall not interfere with nor back-feed into other electrical circuits.
10. Wiring added from OEM chassis wiring to rear lights, fuel tank, and/or other accessories shall be supported and protected from the ice and snow build-up. Wiring shall be inside bus where possible. Wiring to taillights and other exterior lights shall be long enough to remove assembly by 6" for service. Exterior connections shall be weatherproof positive lock connectors coated with dielectric grease. Suggested sources: Metri-pak, Weather-Pak.
11. Scotch lock wire connectors are not acceptable and shall not be used for wiring installation. Terminals shall be as follows:
  - a. Machine crimped on wire ends shall be used on all harnesses and cable assemblies used in the production of buses. Harness assemblies shall have connectors matching a mating connector where harnesses attach to other harnesses, switches, or other electrical units. Connections made in any harness assembly shall use Sta-Kon® disconnects and splice connectors where machine applied connectors cannot be used. Connectors shall be properly crimped with Sta-Kon® tools and covered with heat shrink tubing. In-line fuse assemblies shall use spade type fuses in a Weather-Pak holder and shall be located for ease of service.
  - b. All exterior wiring connectors (plug-ins) including harnesses shall be weatherproof positive lock with the connector pins applied with the proper crimping tool (Weather-Pak, Metri-Pak). All exterior ground connections, except factory supplied braided ground straps, shall have properly applied terminal ends with heat shrink insulation applied.

## **VI. ALTERNATE QUOTES (OPTIONS)**

### **A. Air Conditioning – Split System**

1. a. The air conditioning system (AC) shall have a separate compressor, condenser, and evaporator for the front system and for the rear system (two separate systems). The systems shall be 12-volt and use refrigerant type R-134A. The

systems shall be of sufficient capacity to maintain interior temperature requirements stated in the test procedure for air conditioning systems during summer operation (see required certification in Vendor/Manufacturer Requirements, Section VII. C).

- b. The front AC system shall be integrated as part of the front heating/ventilating unit including the driver's area evaporator unit (complete front system may be Chassis OEM with OEM controls and sensors). The front system shall provide temperature control with sufficient cooling ventilators for driver comfort with no reliance on the rear system for front temperature control. Front and rear air flow and temperature shall be controlled by separate switches on the driver's control panel or dash panel. Front and rear systems shall have separate fan, evaporator, and compressor controls.
  - c. The rear system shall have an electronic control systems capable of providing automatic temperature control, freeze protection, compressor protection, and diagnostic functions. The driver's automatic temperature and system control panel shall be mounted in the driver's station. The control system shall be an integral part of the system temperature controls. The system shall be able to monitor system voltage, high refrigerant pressure, low refrigerant charge, and clutch cycling intervals and shall protect the system by controlling compressor clutch engagement. The system shall be able to interpret associated problems and provide codes for technician diagnosis. Suggested source: Carrier Transicold, Total Control, Thermo King Clima Aire.
2. Compressors: There shall be two engine mounted, serpentine belt driven air conditioning compressors of nominal 10 cu. in. displacement each, minimum, one for the front system (may be chassis OEM) and one for the rear system. Hose end metal fittings connecting hoses to the compressor shall be electro-coated steel that pass the ASTM B117 1000 hour Salt Spray test. The compressor clutch circuit shall be interrupted when abnormal pressures are detected by the pressure monitoring switches. Low pressure switch shall be located between the expansion valve and the compressor in the low pressure side of the system. The high pressure switch shall be located between compressor and condenser in the high pressure side of the system. Suggested sources: American Cooling Technology, Inc., Carrier Transicold, Thermo King, Trans/Air.
  3. Condensers: The rear system's condenser shall be roof mounted (10" or less in height) and may use the Chassis OEM radiator mounted condenser for the front system. The protective external grille work for the roof mounted condenser coil fins shall not be mounted directly against the condenser fins. The condenser fans and motors shall be enclosed within the condenser housing. The housing shall be galvanized with heat-fused powdered epoxy coating. The condenser coil shall be copper or aluminum tube expanded into aluminum fins and vinyl-coated. Hose end metal fittings connecting hoses to the condenser shall be electro-coated steel that pass the ASTM B117 1000 hour Salt Spray test. High pressure cut out switches shall be wired into the clutch circuit. The condensers shall be equipped with axial fans dynamically balanced with permanent magnet totally enclosed motors. The condensers shall blow air upward and toward the rear of the bus assisted by the forward motion of the bus. A refrigerant dryer and a sight glass where necessary shall be included in the system. A branch guard the same height as the condenser shall be mounted just forward of the condenser assembly on the roof of the bus which shall not restrict air flow into the condenser assembly. Suggested sources for

roof mounted condenser: American Cooling Technology, Inc., Carrier Transicold, Thermo King, Trans/Air.

4. Evaporator(s)
  - a. The front evaporator (may be chassis OEM equipment) and rear evaporator(s) shall have three-speed continuous duty permanently lubricated blower motors (rear blower assembly rated at 1985 CFM, minimum). The rear evaporator cores shall be a copper coil with aluminum fins (three rows deep, minimum), galvanized heavy-duty frame and coil end sheets with a galvanized or plastic drain pan. The rear evaporator expansion valve shall have "O" ring refrigerant connections. Suggested sources: American Cooling Technology, Inc., Carrier Transicold, Thermo King, Trans/Air.
  - b. The driver's evaporator (may be chassis OEM equipment) shall be controlled separately from the rear passenger area evaporator. The controls shall include an on/off switch and a three-speed blower switch. The in-dash unit shall not interfere with removal or replacement of the engine cover or be blocked by the entrance door control mechanism.
  - c. The passenger area evaporator system shall be separately controlled from a control station at the driver's position. The controls shall include an on/off switch and a three-speed blower switch. The evaporator shall be ceiling mounted at the rear of the passenger compartment.
5. The components of the air conditioning system shall be readily accessible for maintenance. Service/charging ports shall be accessible without removing any other component or item. The refrigerant hose construction shall comply/exceed SAE specification J2064 Type D or E. The construction of the hose shall include a nylon-based thermoplastic inner liner reinforced with two separate layers of textile yarn and a cover consisting of a synthetic elastomer in order to reduce incidences of chaffing, cuts, and ruptures with adequate extra length for flexing where connected to compressors and other components. Refrigerant fitting construction shall comply/exceed SAE specification J2064 Type D or E. All refrigerant hose end fittings shall be electro-coated steel that will pass the ASTM B117 1000 hour Salt Spray test. The hose coupling end of all fittings shall include two hose barbs and two areas of elastomeric or HNBR seals. Refrigerant hose clamp construction shall: comply/exceed SAE specification J2064 Type D or E; be made of stainless steel to ensure coupling integrity; properly align hose end fitting; and clamp the hose directly over the elastomeric or HNBR seals. Refrigerant hose fittings shall be Aeroquip E-Z Clip system, Carrier Transicold Quick-Klik system.
6. The wiring shall meet all applicable specifications (see Section V. B.). The evaporator and condenser wiring (power and ground circuits) shall be properly sized to provide full battery voltage to each electrical unit.
7. Air conditioning electrical circuits shall be protected with automatic circuit breakers or thermal relays.
8. The rear air conditioning system shall be supplied from the equipment manufacturer as a complete unit including controls, wiring and hoses. The whole system shall be warranted from in-service date, by the manufacturer, for a period of two years with unlimited mileage.

## **B. Air Conditioning / Heat – Rooftop System**

The rooftop AC system shall meet all of the requirements of the AC split system except that the rear evaporator and heating unit shall be an integral part of the rooftop AC unit so that the condenser unit, evaporator unit, and heating unit are part of a single roof mounted unit. A coolant circulating pump shall be installed in the coolant lines for the rooftop heating unit. The auxiliary coolant heating unit and coolant pump for the rooftop heating unit shall be connected electrically to run whenever the bus's rooftop unit calls for heat. The rooftop unit shall be a free blow system installed in the central roof area of the passenger compartment of the bus. The air conditioning/heating system shall be supplied from the equipment manufacturer as a complete unit including controls, wiring and hoses. A branch guard shall be installed to protect the roof-mounted air conditioner. The whole system shall be warranted from in-service date, by the manufacturer, for a period of two years with unlimited mileage. American Cooling Technology, Inc., Carrier Transicold, Thermo King, Trans/Air.

## **C. Destination Sign**

A 24-volt, solid state, LED destination sign shall be provided which meets ADA requirements (one front and on side sign). Sign shall include a 12-volt to 24-volt converter to power the sign. Sign shall be programmable using the latest version of Microsoft Windows<sup>®</sup> based software. Suggested sources: Luminator VISTA, TwinVision<sup>®</sup>

## **D. Ceiling Handrails**

1. Two full length transit-type ceiling handrails shall be provided and securely attached to roof structure on all buses used in fixed route service (line haul). The handrails shall be a minimum of 1¼" outside diameter, brushed finish, stainless steel including mounting brackets and fittings. All handrails shall meet ADA requirements for position and size.
2. All handrail mountings shall have reinforcement plates welded to or imbedded in structure behind surface panels of sufficient strength to withstand passenger force. Final locations shall be determined at pilot model production

## **E. Donation Box**

A donation box (to replace the farebox) shall be mounted on an adequately braced stanchion; shall be located over a flat floor surface near the driver; and shall be accessible to passengers entering the bus (meet ADA requirements). The lockable donation box shall be supplied with two keys (location shall be approved by the State at pilot model inspection). Suggested source: Main Farebox Model C91M.

## **F. Farebox Electrical Prep**

Electrical connections and wiring only (no farebox) along with support stanchion shall be supplied to the area where the standard farebox would be mounted (location shall be approved by the State at pilot model inspection).

## **G. Limited Slip Differential**

The limited slip differential powers both wheels yet freely permits wheel speed differentiation when required during turning using standard OEM equipment.

## **H. Rear Emergency Exit Window**

1. A bus equipped with a rear exit window shall have the window opening be approximately 1,200 square inches. The rear window shall have a latching device for opening from the inside of the bus which may be quickly released but designed to offer protection against accidental release. Lever-type latches shall be used for rear emergency exit windows and shall secure the windows tightly shut, shall be easily operated, and shall not unlatch due to vibration during normal bus operation. The latches shall be made of non-corrosive materials and be designed for minimal maintenance needs. The rear window exit shall meet federal requirements (FMVSS 217). The rear window exit shall have an audible alarm at the driver's area energized when the window starts to open with the ignition on. A clear full width path of 16" minimum height shall be provided to the rear exit window. No objects shall be placed in bus which restricts passageway to rear exit window. All emergency exits shall be marked with instructions for proper use.
2. The bus rear exit window shall have a glue-on wide angle view Fresnel lens to improve vision directly in back of bus. Minimum size shall be 80 square inches. Suggested source: Vanguard made by 3M.
3. On buses with a rear exit window, forward facing seating for five passengers shall replace two double place forward facing seats at the rear wall of the passenger compartment increasing the passenger capacity by one. The five passenger seating shall be available for buses with the lift forward of the rear axle and those with the passive lift option (no wheelchair lift or securement location at the rear of the bus). The five passenger seat shall be 88" minimum width and shall comply with all requirements specified in Section II., Part P., Item 4. and Item 5. of these specifications but without grab handles. The seats shall be of the same design as the other passenger seats.

#### **I. Paint – Optional Designs**

1. The bus shall have an 11" belt painted stripe (no decals). An example would be: an OEM white bus with a 11" belt stripe.
2. The bus shall have the roof painted a different color. An example would be: an OEM white bus with the roof painted red.
3. The bus shall be painted a full body color, including the roof, other than OEM white. An example would be: a bus painted all red.

#### **J. Type II Lift, Passive (Platform) (Meet ADA Requirements)**

The Type II platform lift shall meet all of the lift requirements stated in Part II, Section Y except that the Type II lift shall have a power operated outer barrier on the lift platform. Suggested sources: Braun, Maxon, Ricon.

#### **K. Folding Platform Passive Lift (Platform) (Meet ADA Requirements)**

The folding platform lift shall meet all of the lift requirements stated in Part II, Section Y except that the lift shall have a platform that folds in the center during stowage and the lift platform is 32" usable width. The folding platform lift provides an unobstructed view from inside the bus through the lift opening. Ricon KlearVue model K-5005 ADA.

## **L. Two-Way Radio Antenna/Power**

All material and labor required for a pre-installation package for two-way radio equipment shall be furnished by the manufacturer. All equipment and accessories installed as part of the buses shall have no measurable radio frequency (RF) interference. All equipment installed on the bus must operate in its normal mode while radio transmissions are being made from an on board transmitter producing 100 watts or more of transmit power while operating in the range of 43 Megahertz (Mhz) to 900 Mhz. Proper RF suppression shall be provided by the manufacturer in any equipment and accessories that can produce interference to eliminate such interference. The bus frame and body shall be designed to provide no measurable radio interference (shielding) for improved radio emissions and reception performance. Certification of radio reception and transmission performance by the bus manufacturer as well as locations of components for installation of the radio packages for 43 Mhz to 900 Mhz shall be completed at pilot model production.

1. Two (2) antenna mounting plates (.060" steel minimum) shall be mounted in the roof of the bus for the purpose of providing a connection to the ground plane and providing a secure mount for the antenna. On buses with a metal exterior skin, one plate shall be mounted forward of the roof escape hatch on the roof center line and the second plate shall be mounted to the left (driver's side) of the first plate just above the bus side window. For buses with FRP composite bodies, the mounting plates may be installed in the front cap of the bus-one centered in the roof section of the cap and one centered in the left (driver's) side section of the cap. Each mounting plate must be properly positioned in relation to its ground plane to ensure proper operation of an antenna installed at that mounting point. The total thickness of the exterior shell of the bus in the mounting plate area including the mounting plate shall be no more than ½".
2. Two (2) antenna ground planes, which are required for proper antenna operation, shall be mounted in each bus. All ground planes shall be radio frequency (RF) grounded to the nearest metal portion of the body structure using high corrosion resistance and high conductivity braided ground straps of the proper size (3/8" minimum width). Ground planes shall provide a comparable area of radio transmission coverage whether buses have a metal exterior body covering or have a FRP composite exterior. At each antenna access opening and mounting plate area, the ground planes shall be of proper size and shape for proper communication operations. The ground planes shall be a solid piece and operate over the range of frequencies from 43 Mhz to 900 Mhz. The ground plane material used by the manufacturer must be a durable material that can be connected to the antenna mounting plate and grounded to the chassis frame. The ground plane shall be of the proper size to protect passengers in the bus from unnecessary radiation from the transmitting antenna at the bus's antenna access openings.
3. A 6" high branch deflector shall be installed on the roof of the bus 6" forward of the antenna mounting area.
4. Two threaded type access holes with covers approximately 6" in diameter shall be installed at the following antenna mounting plate locations:

- a. The interior ceiling forward of the roof escape hatch.
  - b. For buses with metal exterior skin directly to the left (driver's) side above the side window line of the bus.
  - c. For buses with FRP composite bodies the screw-type access holes may be installed in the front cap of the bus, one centered in the roof section of the cap and one centered in the left side section of the cap. Adequate space shall be provided between the installed access cover and the inner body to allow for routing of the antenna lead and its connections without interference.
5. A concealed thin wall plastic conduit, 5 / 8" I.D. minimum, (with antenna cable pull wire) shall extend from the antenna mounting plate locations (roof and above side window or in front cap) to the mounting location for the radio. When installed, the conduit shall have no sharp or right angle bends or be distorted to prevent insertion of the antenna lead. For both antenna mounting plate locations, sufficient space shall be left at each end of the conduit to allow easy removal and replacement of the devices attached to the cable. The antenna pull wire shall terminate behind the driver's seat with 2 feet of extra length extending into the bus interior.
  6. 12-Volt Power for the Two-Way Radio - The positive lead (red 8 ga wire fused at 40 amperes) for the radio connection shall be provided directly from the battery positive post. The ground lead (black, 8 ga) shall be connected directly to the chassis frame with a bolt, external tooth lock washers, and nut for fastening. Proper suppression equipment shall be incorporated in the bus's electrical system to eliminate interference with radio and television transmission and reception shall not cause interference with any electronic system on the bus. The radio power and ground leads shall terminate directly behind the driver's seat with 12 feet of extra length extending into the bus interior.
  7. A split loom or other flexible wire race-way (1" minimum) shall be installed from the radio location to the dash mounted microphone control location.
  8. The modesty panel behind the driver shall be used for radio mounting and shall be constructed to support 60 pounds of weight. To provide for radio mounting, a 5" minimum distance shall be provided between the driver's seat and the modesty panel when the driver's seat is in its most rearward travel position.

#### **M. Rubber Shear Spring Front Suspension**

The chassis shall be equipped with a heavy-duty front suspension fitted with a rubber shear spring suspension that works in conjunction with the OEM chassis leaf spring suspension to match the specified gross axle weight rating. The added suspension, consisting of a spring carrier assembly, a frame hanger assembly, a lateral movement control feature, a cross-member tube assembly, and a carrier spring assembly, shall be installed in place of the original spring hanger and shackle assembly. The frame hanger must bolt into the existing Original Equipment Manufacturer (OEM)

spring hanger holes in the frame. The added suspension system must not alter the OEM gross axle weight rating. MOR/ryde® “RL” Suspension System.

#### **N. Rear Air Ride Suspension**

The rubber shear spring rear suspension will be replaced with rear axle air ride suspension. The rear axle air ride suspension shall be a spring-beam with air spring (Firestone) on each side with a capacity to match the axle weight rating. Rear air suspension shall use original chassis spring hangers, original axle clamp group, original shock absorbers, and suspension stabilizer (where equipped). The air suspension shall have a single valve for the rear axle height control. The air system shall be complete with its own air compressor, air lines, and reservoir tank(s) with manual spitter and drain valves with pull chains (Berg manual). The air system shall have a dash mounted air pressure gauge, warning light and warning buzzer. Suggested sources: Chassis OEM equipment.

#### **O. Smooth Anti-slip Flooring**

1. The entire passenger area including the wheelchair securement area, entrance steps and stepwell area, shall be overlaid with smooth, slip resistant flooring material. The resilient sheet flooring system (2.2 mm thickness minimum) shall be a high quality vinyl with aluminum oxide and color quartz grains throughout the thickness, silicon carbide grains in the surface layer and a non woven polyester/cellulose backing with glass fiber reinforcement. The flooring shall extend up the sidewall and rearwall to the seat rail line and shall be coved at the floor/wall joint to form a smooth water tight transition. Installation of flooring must be done strictly according to the flooring manufacturer’s directions using the proper accessories, tools, and adhesives. Suggested Sources: Altro Transflor™ Meta, Altro Transflor™ Chroma.
2. Step treads shall be one-piece resilient sheet flooring system matching the passenger compartment flooring. All step edges (nosings of step tread material) shall have a band of bright yellow contrasting color running full width of the step. Step tread to stepwell joints shall be sealed to prevent intrusion of moisture and debris. An aisle width standee line of bright yellow contrasting color shall be in the aisle just behind stepwell (must meet ADA contrast requirement). Suggested Sources: Altro Safety Step System

#### **P. Entrance Stepwell Heater**

The entrance stepwell shall include a 12-volt electric heating element/unit for the lower step to prevent icing of entrance steps. The low voltage step heater shall consist of one or more wire elements laminated and vulcanized between two plies of .026" silicone rubber impregnated fiberglass cloth to maintain an approximate temperature of 160° F with a low temperature (30°F) sensing switch (Warm Welcome® by Lighthouse International, Ltd.). The entire lower step heating unit with power wires shall be enclosed between the stepwell and the step tread (beneath the step tread) of the lower step. Lead wires shall be loomed, supported by brackets, and protected by grommets where they pass through structure. The sensing switch (thermostat) shall be integral with the power feed wire and located outside the stepwell in a protected area under the bus or be integral with a separate short harness that plugs into the feed wire under the bus.

**Q. Electric Driveline Brake (Retarder)**

The bus shall be equipped with a self air-cooled eddy current electric driveline brake (retarder). Main components of the brake shall be electromagnets (brake coils) fixed to the bus frame, two vented rotors, and a controller. The brake shall be mounted between the transmission and the rear axle. The brake shall be of sufficient capacity to match the bus GVWR. The brake control that energizes the brake coils shall be either electronic or mechanical and be compatible with ABS brakes (retarder deactivates when ABS controls wheel rotation). The controller shall be activated by stage switches engaged by brake pedal movement. Suggested sources: Telma.

**R. Natural Gas Application**

The bus shall accept Compressed Natural Gas (CNG) or Liquefied Natural Gas application if required for fleet compliance by federal Environmental Protection Agency (EPA) alternate fuel application guidelines. Availability of this option is for demonstration or experimental units only (special purchase by the State). This option will not be used in the evaluation of the total bid and is for information only.

On buses ordered with alternate fuels options (propane, CNG, etc.) auxiliary heater systems installed shall meet the same specifications for the systems operating on diesel fuel. Additionally, a diesel fuel tank shall be added with a minimum working capacity of 8 gallons with a 1 gallon reserve. All heated air models shall have a 12-volt heater booster pump installed in the coolant line forward of the first rear heater. Additional equipment needed for auxiliary heater shall be included in the option. Suggested sources: Bergstrom 863040

**VII. VENDOR/MANUFACTURER REQUIREMENTS**

**A. Bus Information Furnished** - Bus information in this section shall be reviewed at the pre-pilot model review meeting, at final pilot model production. Bus information identified by “ \* ” shall also be supplied with each bus at delivery where indicated. All manuals shall be provided in a hardcopy and an electronic copy (CD or DVD). The vendor/manufacture shall maintain record or proof that all bus information was supplied to the transit agency.

1. Copy of manufacturer's statement of origin for a bus.
- 2.\* Warranty papers for chassis, body, and additional equipment with each bus at delivery.
- 3.\* As built drawings showing wiring schematics of all electrical circuits, body, and chassis with each bus at delivery.
- 4.\* Operator's manual for bus and all add-on equipment with each bus.
- 5.\* A complete set of repair manuals for the chassis and a manufacturer's parts manual for the body, and auxiliary equipment for the first bus of each model year delivered to each transit agency.

- 6.\* Drivability and emissions manual for the first bus of each model year delivered to each transit agency.
- 7.\* Bus operating instructions showing controls and operation on a DVD for the first bus delivered to each transit agency.
- 8\*. Standard manufacturer's production option sheet(s)/decal(s) for chassis and body shall be installed in manufacturer's standard location, with no holes or rivets obscuring writing and numbers. Sheet shall include rear axle ratio. A paper copy of the service broadcast sheet for chassis shall also be provided with each bus.
- 9.\* Maintenance and inspection schedule incorporating the required maintenance and inspection of the basic bus and its subsystems (i.e., wheelchair lift) with each bus at delivery.
10. Detailed description and specifications of the frame structure, roof structure, side sheathing, inside panels, with particular reference to material used.
11. Detailed drawing on how body structure is mounted on chassis frame.
12. Certification that seating floor anchorage and floor fasteners shall meet all applicable FMVSS including FMVSS 207, 208, 209, and 210.
- 13.\* Proof of bus suspension alignment (work order or bill) at final bus inspection and with each bus. Four wheel alignment shall include adjustments to front and rear suspension and steering parts so that axle alignment, camber, caster, and toe settings are within manufacturer's desired limits.
- 14.\* Proof of undercoating (warranty) at final bus inspection and with each bus.
- 15.\* Front end and rear towing and lifting instructions with each bus.
- 16.\* Wheelchair securement product instructions and training program.

## **B. Manufacturer Quality Control**

Bus contractor/manufacturer shall provide a plan for quality control during bus construction and include the plan as part of the bid documents. Bus contractor/manufacturer shall also provide the name of the chief of quality control for bus construction.

The contractor shall establish and maintain an effective in-plant quality assurance organization. It shall be a specifically defined organization and should be directly responsible to the contractor's management and completely independent from production. The quality assurance organization shall exercise quality control over all phases of production from initiation of design through manufacture and preparation for delivery. The organization shall also control the quality of supply articles. The quality assurance organization shall verify inspection operation instructions

to ascertain that the manufactured product meets all prescribed requirements. The quality assurance organization shall detect and promptly assure correction of any conditions that may result in the production of defective transit buses. These conditions may occur in design, purchases, manufacture, tests or operations that culminate in defective supplies, services, facilities, technical data, or standards. The contractor shall maintain drawings and other documentation that completely describe a qualified bus that meets all of the options and special requirements of this procurement. The quality assurance organization shall verify that each transit bus is manufactured in accordance with these controlled drawings and documentation.

The contractor shall ensure that all basic production operations, as well as other processing and fabricating, are performed under controlled conditions. Establishment of these controlled conditions shall be based on the documented work instructions, adequate production equipment, and special work environments if necessary. A system for final inspection and test of completed transit buses shall be provided by the quality assurance organization. It shall measure the overall quality of each completed bus. A system shall be maintained by the quality assurance organization for identifying the inspection status of components and completed transit buses. Identification may include cards, tags, or other quality control devices. Inspection stations shall be at the best locations to provide for the work content and characteristics to be inspected. Stations shall provide the facilities and equipment to inspect structural, electrical, hydraulic, and other components and assemblies for compliance with the design requirements. Stations shall also be at the best locations to inspect or test characteristics before they are concealed by subsequent fabrication or assembly operations. These locations shall minimally include, as practical, under-body structure completion, body framing completion, body prior to paint preparation, water test before interior trim and insulation installation, engine installation completion, under-body dress-up and completion, bus prior to final paint touch-up, bus prior to road test, bus final road completion and presentation to resident inspectors. Tests shall be performed by the bus manufacturer to ensure that the unit is dustproof, water-tight, fumeproof, and that all bus fluids are per specifications. The quality assurance organization shall be responsible for presenting the completed bus to the resident inspectors. Sufficiently trained inspectors shall be used to ensure that all materials, components, and assemblies are inspected for conformance with the qualified bus design.

The State may be represented at the contractor's plant by resident inspectors. They shall monitor, in the contractor's plant, the manufacture of transit buses built under this procurement. The contractor shall provide office space for the resident inspectors in close proximity to the final assembly area. This office space shall be equipped with desks, chairs, outside and interplant telephones, and other items sufficient to accommodate the resident inspector staff. Inspectors shall have lifting equipment available for raising vehicles for under vehicle inspections.

### **C. Air Conditioning Certification**

The bus manufacturer shall provide air conditioning system performance certification (conducted by an independent laboratory, or testing agency, or the air conditioner manufacturer and supported by documentation of the actual test on the pilot model bus) that the air conditioning system installed in the bus meets or exceeds performance levels required by these specifications.

1. The air conditioning system performance testing shall be conducted using a heating chamber of sufficient size to contain the basic bus, to heat soak the bus at 100°F for 4 hours minimum, to simulate sun load entering windshield, and to maintain 100°F exterior temperature continuously after heat soak during testing. An interior temperature of 72°F ( $\pm 3^\circ\text{F}$ ) must be reached within 30 minutes from the beginning of the test. Engine speed shall be maintained at 1300 RPM ( $\pm 200$  RPM) during the test.
2. Instrumentation for temperature monitoring of the bus interior shall be a minimum of 3 points in the passenger area 30" above the floor - one in driver's area at knee level, and one at the evaporators' air inlets and air outlets. Instrumentation and recording equipment shall be able to monitor all points, record data at one minute intervals, and print a data report.

#### **D. Heating/Ventilating Certification**

The bus manufacturer shall provide test results that certify the performance of the heating/ventilating system as installed in the bus meets or exceeds performance levels required by these specifications. The test should be conducted by an independent laboratory or testing agency and supported by documentation of the actual tests on the pilot model bus. Testing may be performed in natural cold climate conditions.

1. The heating system performance testing shall be conducted using a cold chamber of sufficient size to contain the basic bus; to cold soak the bus at 0°F for 12 hours; to maintain 0°F continuously after cold soak during testing; and be equipped with a chassis dynamometer to simulate road operation under conditions encountered in normal transit operations with a 20% load of passengers, 1 wheelchair and a bus driver. An average interior temperature of 60°F must be reached within 30 minutes from the beginning of the test. After initial warm-up while the bus is in passenger service, the front and rear heavy-duty heating system shall be sufficient to maintain a minimum of 64°F at knee level throughout interior of bus and at the driver's foot space when the outside temperature is 0°F. The test procedures shall be completed: 1) to show actual temperature rise from static parked condition; 2) to simulate an average bus route; and 3) to measure coolant flow rates in the heater circuits at idle and at operating speeds.
2. The test is to be: 1) warm-up of 15 minutes with 8 minutes @ idle and 7 minutes @ 35 mph road load; 2) idle bus, 3 minutes [passenger boarding - door open for 1 minute]; 3) run @ 25 mph for 5 minutes, run @ idle 3 minutes [passenger boarding - door open for 1 minute]; 4) run @ 25 mph for 5 minutes, run @ idle for 8 minutes [wheelchair boarding - doors open for 4 minutes]; 5) 2 cycles of run @ 25 mph for 5 minutes, idle 3 minutes [passenger boarding - door open for 1 minute]; 6) run @ 25 mph for 5 minutes, run @ idle for 8 minutes [wheelchair boarding - doors open for 4 minutes]; 7) 2 cycles of run @ 25 mph for 5 minutes, idle 3 minutes [passenger boarding - door open for 1 minute]; 8) run bus at 35 mph for 6 minutes; and 9) idle bus, 5 minutes. Total test operation cycle of 95 minutes.
3. Instrumented monitoring for the bus interior temperature shall be a minimum of 3 points located front, center, and rear in the passenger area 30" above the floor -- one in driver's

area at knee level 22" above the floor, at front heater's air inlets and air outlets, and at rear heater's air inlets and air outlets. Other temperature monitoring points shall be: engine operating (coolant); engine oil; engine outlet to heater; heater return at engine or radiator; and exterior ambient. Coolant flow shall be monitored from the engine outlet to the heaters and for coolant flow through each circuit to the heater unit. Normal engine operating temperature shall be reached 30 minutes into the test and shall be maintained throughout the performance test. Supplemental heat shall be supplied to raise engine to normal operating temperature if testing conditions fail to raise the engine to normal operating temperatures at 30 minutes into the test. The standard used for this test for normal engine operating temperature is determined by the engine manufacturer's specifications. Instrumentation and recording equipment shall be able to monitor all points, record data at one minute intervals, and print a data report.

#### **E. Purchaser Inspection**

The purchaser reserves the right and shall be at liberty to inspect all material and workmanship at all times during the progress of the work, and shall have the right to reject all material and workmanship which do not conform with the specifications or accepted practice. Where a resident inspector is used, upon the request to the quality assurance supervisor, the resident inspectors shall have access to the Contractor's quality assurance files related to this procurement. These files shall include drawings, material standards, parts lists, inspection processing and records, and record of defects.

#### **F. Warranty**

Warranty shall become effective on the date the bus is placed into service by the purchaser. Warranty service performed at the manufacturer's facilities at the manufacturer's request shall have all costs covered by the manufacturer. Warranty for the bus shall be the following as a minimum:

1. Two (2) years unlimited mileage on chassis.
2. Two (2) years unlimited mileage on transmission.
3. Three (3) years on body structure, exterior and paint.
4. Eighteen (18) months on lift.
5. All wiring shall be warranted for one 1 year from date of delivery.
6. Manufacturer's standard warranty of one (1) year 12,000 miles, minimum, on other add-on components and items.
7. The chassis, body, and all add-on components shall be warranted by the successful contractor.

#### **G. Miscellaneous**

1. The vendor shall furnish the State with the delivery schedule of chassis to vendor and a delivery date of completed buses within 30 calendar days from date of order.
2. Any in-line equipment changes shall have prior written approval of the State.
3. The vendor shall supply the bus turning radius: wheel-to-wheel and wall-to-wall.
4. The vendor shall furnish warranty procedure instructions and necessary forms used by customers to obtain necessary warranty repairs.
5. The manufacturer(s) shall produce as the pilot model the first bus ordered by the State for its transit agencies. The bus shall be: 1) lift equipped, 2) air conditioned, and 3) the largest size on request by the transit agencies. All necessary testing and equipment placement shall be performed on the pilot models before final inspection/acceptance by the State. The pilot model shall serve as a standard for the following units as ordered but shall not relieve the contractor from an obligation to manufacture all units in compliance with all specifications.

## **VIII. BID DOCUMENTS**

### **The bidder shall supply two copies of the following with the bid quotation:**

- A. The Michigan Bus Specification forms completed in detail.
- B. A floor plan of the bus shall be provided indicating dimensions and showing the interior layout of the bus. The plan shall include wheelchair placement, stanchion locations, engineering calculated loaded bus axle weights, and be drawn to scale for all configurations.
- C. Detailed engineering drawing for the design of the entrance door and door opening device (with drawings).
- D. Detailed engineering drawing for the design of the entrance step configuration (with drawings).
- E. Roof, sidewall, and flooring drawings showing structure and structural specifications indicating metal size and type used. Include side sheathing and inside panels.
- F. A description of the manufacturer's chassis (specifications).
- G. Detailed engineering drawing on how body structure is mounted on chassis frame.
- H. All bidders must supply manufacturer's technical specifications for wheelchair lifts and wheelchair restraints. Manufacturer's sales literature is acceptable if it contains the technical specifications.

- I. The warranties for body, chassis, and drive train.
- J. A copy of the Bus Rollover Protection Test (FMVSS 220) results of the bus offered as specified in the bid.
- K. The required Federal Transit Administration (FTA) clauses shall be attached to bid quotation.
- L. The technical data sheet including flammability and smoke emissions for the seat covering material supplied.
- M. Seat frame Salt Spray, humidity and impact resistance tests' results
- N. Certification test data showing that the seats, the seat belts, and the installation are in compliance with FMVSS-207, 208, 209, and 210 where applicable for the bus model being offered in this bid.
- O. Certification that the wiring and the switches for air conditioning and all add-on components are adequate to withstand transient loads expected.
- P. A copy of the dealer agreement between the Bus Manufacturer and the designated dealer.
- Q. Certification that the bus model offered is a 7 year or 200,000 mile bus and will meet the requirements of Federal Register Rules and Regulations 49 CFR Part 665, Bus Testing Program. Stating from § 665.13 Test Report and Manufacturer Certification, Section (b)(1), "A manufacturer of a new bus model or a bus produced with a major change in component or configuration shall provide a copy of the test report to a recipient during the point in the procurement process specified by the recipient".

## IX. TABLE 1

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1. Materials tested for surface flammability should not exhibit any flaming running, or flaming dripping.

2. The surface flammability and smoke emission characteristics of seat cushion materials should be demonstrated to be permanent after testing according to ASTM D-3574 Dynamic Fatigue Tests  $I_s$  (Procedure B).

3. The surface flammability and smoke emission characteristics of a material should be demonstrated to be permanent by washing, if appropriate, according to FED-STD-191A Textile Test Method 5830.

4. The surface flammability and smoke emission characteristics of a material should be demonstrated to be permanent by dry cleaning, if appropriate, according to ASTM D-2724. Materials that cannot be washed or dry-cleaned should be so labeled, and should meet the applicable performance criteria after being cleaned as recommended by the manufacturer.

5. ASTM E-662 maximum test limits for smoke emission (specific optical density) should be measured in either the flaming or non-flaming mode, depending on which mode generates more smoke.

6. Flooring and Fire Wall assemblies should meet the performance criteria during a nominal test period determined by the transit property. The nominal test period should be twice the maximum expected period of time, under normal circumstances, for a vehicle to come to a complete, safe stop from maximum speed, plus the time necessary to evacuate all passengers from a vehicle to a safe area. The nominal test period should not be less than 15 minutes. Only one specimen need be tested. A proportional reduction may be made in dimensions of the specimen provided that it represents a true test of its ability to perform as a barrier against vehicle fires. Penetrations (ducts, piping, etc.) should be designed against acting as conduits for fire and smoke.

7. Carpeting should be tested in according with ASTM E-648 with its padding, if the padding is used in actual installation.

8. Arm rests, if foamed plastic, are tested as cushions.

9. Testing is performed without upholstery.

### Definition of Terms

1. Flame spread index ( $I_s$ ) as defined in ASTM E-162 is a factor derived from the rate of progress of the flame front ( $F$ ) and the rate of heat liberation by the material under test ( $Q$ ), such that  $I_s = F_s \times Q$ .

2. Specific optical density ( $D_s$ ) is the optical density measured over unit path length within a chamber of unit volume produced from a specimen of unit surface area, that is irradiated by a heat flux of 2.5 watts/cm<sup>2</sup> for a specified period of time.

3. Surface flammability denotes the rate at which flames will travel along surfaces.

4. Flaming running denotes continuous flaming material leaving the site of the burning material at its installed location.

5. Flaming dripping denotes periodic dripping of flaming material from the site of burning material at its installed location.

### Referenced Fire Standards

The source of test procedures listed in Table 1 is as follows:

(1) Leaching Resistance of Cloth, FED-STD-191A-Textile Test Method 5830.

Availability from: General Services Administration Specifications Division,

Building 197, Washington, Navy Yard, Washington, DC 20407.

(2) Federal Aviation Administration Vertical Burn Test, FAR-25-853.

Available from: Superintendent of Documents, US Government Printing Office, Washington, DC 20402.

(3) American Society for Testing Materials (ASTM)

(a) Surface Flammability of Materials Using a Radiant Heat Energy Source, ASTM E-162;

(b) Surface Flammability for Flexible Cellular Materials Using a Radiant Heat Energy Source, ASTM D-3675;

(c) Fire Tests of Building Construction and Materials, ASTM E-119;

(d) Specific Optical Density of Smoke Generated by Solid Materials, ASTM E-662;

(e) Bonded and Laminated Apparel Fabrics, ASTM D-2724;

(f) Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams, ASTM D-3574.

Available from: American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

In all instances, the most recent issue of the document or the revision in effect at the time of request should be employed in the evaluation of the material specified herein.

Issued: October 14, 1993.

Grace Crumican,  
Deputy Administrator.

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**IX. TABLE 1**

**TABLE 1: RECOMMENDATIONS FOR TESTING THE FLAMMABILITY AND SMOKE EMISSION CHARACTERISTICS OF TRANSIT BUS AND VAN MATERIALS**

Category	Function of Material	Test Procedure	Performance Criteria
Seating	Cushion <sup>1;2;3;5;9*</sup>	ASTM D-3675	$I_p \leq 25$
		ASTM E-662	$D_p(1.5) \leq 100; D_p(4.0) \leq 200$
	Frame <sup>1;5;8</sup>	ASTM E-162	$I_p \leq 35$
		ASTM E-662	$D_p(1.5) \leq 100; D_p(4.0) \leq 200$
	Shroud <sup>1;5</sup>	ASTM E-162	$I_p \leq 35$
		ASTM E-662	$D_p(1.5) \leq 100; D_p(4.0) \leq 200$
Upholstery <sup>1;3;4;5</sup>	FAR 25.853 (Vertical)	Flame time $\leq 10$ seconds; burn length $\leq 6$ inches	
	ASTM E-662	$D_p(4.0) \leq 250$ coated; $D_p(4.0) \leq 100$ uncoated	
Panels	Wall <sup>1;5</sup>	ASTM E-162	$I_p \leq 35$
		ASTM E-662	$D_p(1.5) \leq 100; D_p(4.0) \leq 200$
	Ceiling <sup>1;5</sup>	ASTM E-162	$I_p \leq 35$
		ASTM E-662	$D_p(1.5) \leq 100; D_p(4.0) \leq 200$
	Partition <sup>1;5</sup>	ASTM E-162	$I_p \leq 35$
		ASTM E-662	$D_p(1.5) \leq 100; D_p(4.0) \leq 200$
	Windscreen <sup>1;5</sup>	ASTM E-162	$I_p \leq 35$
		ASTM E-662	$D_p(1.5) \leq 100; D_p(4.0) \leq 200$
	HVAC Ducting <sup>1;5</sup>	ASTM E-162	$I_p \leq 35$
		ASTM E-662	$D_p(4.0) \leq 100$
Light Diffuser <sup>5</sup>	ASTM E-162	$I_p \leq 100$	
	ASTM E-662	$D_p(1.5) \leq 100; D_p(4.0) \leq 200$	
Flooring	Wheel Well and Structural <sup>6</sup>	ASTM E-119	Pass
	Carpeting <sup>7</sup>	ASTM E-648	C.R.F. $\geq 0.5$ w/cm <sup>2</sup>
Insulation	Thermal <sup>1;3;5</sup>	ASTM E-162	$I_p \leq 25$
		ASTM E-662	$D_p(4.0) \leq 100$
	Acoustic <sup>1;3;5</sup>	ASTM E-162	$I_p \leq 25$
		ASTM E-662	$D_p(4.0) \leq 100$
Miscellaneous	Firewall <sup>6</sup>	ASTM E-119	Pass
	Exterior Shell <sup>1;5</sup>	ASTM E-162	$I_p \leq 35$
		ASTM E-662	$D_p(1.5) \leq 100; D_p(4.0) \leq 200$

\* Refers to Notes on Table 1

## **X. BUS SEATING ARRANGEMENTS**

The 24-passenger nonlift bus and lift bus (26 foot bus) shall be supplied as requested in the following seating arrangements:

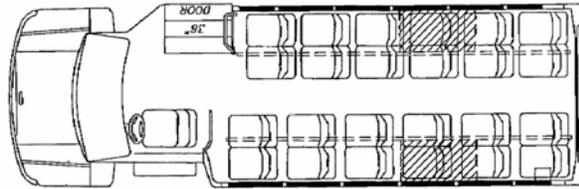
- A. 24 passenger with out lift
- B. 14+2 passenger with active lift
- C. 10+3 passenger with active lift

The 28-passenger nonlift bus and lift bus (29 foot bus) shall be supplied as requested in the following seating arrangements:

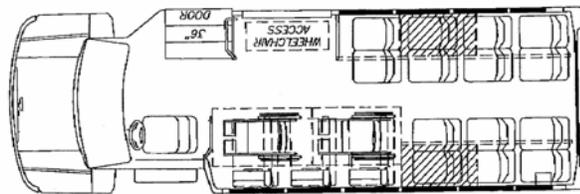
- A. 28 passenger with out lift
- B. 18+2 passenger with active lift
- C. 16+3 passenger with active lift
- D. 12+4 passenger with active lift

Drawings for the suggested seating arrangements are supplied on the following pages.

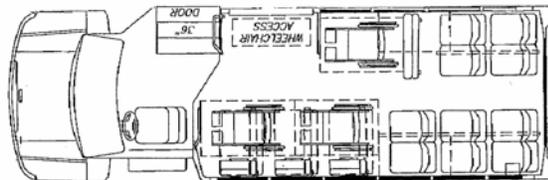
**BUS FLOOR PLANS**  
**26 Foot Medium Duty Bus**  
**Diesel Only**



**24 Passenger Bus w/o Lift**

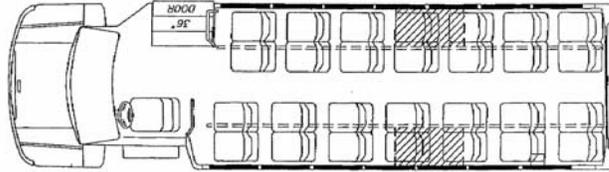


**14+2 Passenger Bus with Active Lift**

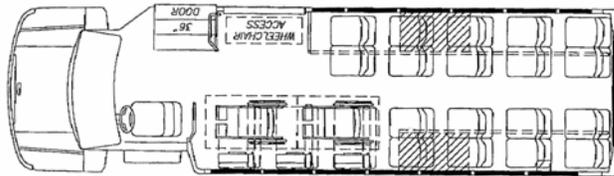


**10+3 Passenger Bus with Active Lift**

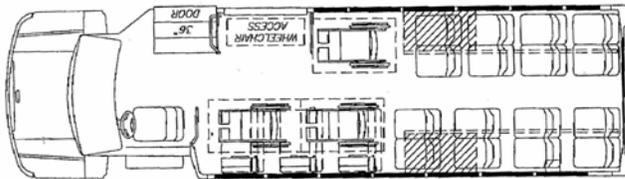
**BUS FLOOR PLANS**  
**29 Foot Medium Duty Bus**  
**Diesel Only**



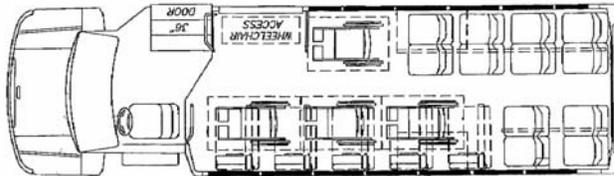
**28 Passenger Bus w/o Lift**



**18+2 Passenger Bus with Active Lift**



**16+3 Passenger Bus with Active Lift**



**12+4 Passenger Bus with Active Lift**

This specification was developed as a cooperative effort between the Michigan Department of Transportation and a committee of representatives from various Michigan public transit agencies.

Upon request, this specification can be obtained in alternative format such as braille, large print, or audio tape.

Contact Michael Frezell, Michigan Department of Transportation, Bus Acquisition and Intercity

Transportation Section, at (517) 335-0904.