

## **BRAKES, SERVICE**

In addition to service brake specifications for combustion engine buses, BEVs will be equipped with a regenerative braking that utilizes the electric drive system in concert with the service brakes to slow the vehicle and return electrical energy to the battery system.

## **DC-DC CONVERTER**

- A. A DC-DC converter shall be provided and deliver a minimum of 200 amps at 12VDC.
- B. The converter system shall incorporate a Ground Fault Interrupt (GFI) that disconnects/isolates the high voltage batteries in the event of a shorted circuit or water intrusion.
- C. Charging connection point shall be outside the passenger compartment

## **EXTERIOR MARKING**

In addition to the marking/labeling specified this manual, BEVs will have clear markings/labeling, with the word "Electric" indicating that the school bus is electric powered.

- A. Image graphics may be used in combination with words.
- B. Lettering will be a minimum of two inches high, blue in color.
- C. Lettering to include imagery shall be located on both sides of the school bus along the roof cap starting above the service door and ending no further than the forward edge of the second passenger window. Additional marking/labeling shall be added to the rear of the bus but shall not be placed in any windows or crowd/encroach on any required emergency/standard markings.

## **HEATING AND COOLING**

Heaters and air conditioning shall be capable of heating and cooling the passenger and driver's compartments.

## **HIGH VOLTAGE SYSTEM**

- A. High Voltage-Powered Vehicles: Buses utilizing a high voltage propulsion system (60 VDC or 30 VAC) shall comply with the following:
  - 1. The propulsion power source (batteries, fuel cells, etc.) shall be located outside the passenger compartment.

2. The propulsion power source enclosure shall be constructed to conform to the power source manufacturer's requirements and recommendations.
- B. Wire, cable, and conductor insulation in the High Voltage System shall provide adequate insulation for the voltage used and for ambient temperatures ranging from - 15°F to 120°F. All high voltage wiring/cabling shall be covered with bright orange loom or otherwise labeled as HIGH VOLTAGE. All high voltage circuits shall provide adequate and automatic protection against electrical overloads caused by short circuits or other excessive current conditions through the use of fuses, circuit breakers, and ground fault interruption.
- C. Each door, cover, or other panel that affords immediate access to any high voltage area shall be plainly marked with a hazard warning label which shall read WARNING—HIGH VOLTAGE or DANGER—HIGH VOLTAGE. This label shall be located in a highly conspicuous place. All high voltage access areas shall be equipped with a lock or otherwise secured to prevent unauthorized access.

### **IGNITION SYSTEM**

- A. The ignition switch circuit shall be linked to the Battery Management System and will prevent the driving of the vehicle while it is connected to an external battery charging source.
- B. The high voltage system shall be designed so that when the ignition switch is off, the high voltage is positively disconnected.

### **LOW SPEED SOUND GENERATOR**

- A. BEVs shall be equipped with a low-speed sound generator to warn other vehicles and pedestrians of the school bus's approach i.e., when approaching an intersections and crosswalks.
- B. The low-speed sound generator shall not emit sound while the bus is completely stopped e.g., while performing a rail grade crossing.

### **PROPULSION SYSTEM/DRIVETRAIN**

- A. Shall be of sufficient power and torque to propel the vehicle fully loaded up to at least 60 mph and no more than 65 mph.
- B. The propulsion system may be mounted utilizing a drivetrain or positioned in a way to provide power to the wheels.
- C. All propulsion systems must be contained below the floor line and cannot come into contact with the road surface.

D. Propulsion system warranties shall be a minimum 5 years/100,000 miles.

### **SEATING**

All seats shall be mounted to minimize contact with batteries and underside of the bus if seat replacement is necessary.

### **SYSTEM PROTECTION**

- A. As part of the Battery Management System, the BEV will be equipped with an automatic shutdown to protect system components from damage caused by malfunctions such as charging/discharging faults, battery overheating, electrical overheating, degraded battery health, etc.
- B. Prior to automatic shutdown, a warning or maintenance indicator shall display in the driver console to notify the driver of impending shutdown or the need for immediate maintenance and allow enough time to safely reposition and stop the bus. Gradual derating of propulsion prior to complete automatic shutdown.



## EQUIPMENT FOR TRANSPORTATION OF PRE-SCHOOL AGE CHILDREN

The school bus is important in the educational development of young children who have special needs because it is the mechanism for transporting them to and from support and development programs. Infants, toddlers, and pre-school children with or without special needs present a particular challenge for transportation personnel because school buses were not designed to transport very young children as passengers. Therefore, these children present multiple challenges to providers of school bus transportation services. Nevertheless, great strides have been made in the types of equipment used to assist pre-school children with or without special needs to safely adapt to school bus transportation.

Challenges relating to proper installation, maintenance and use of Child Safety Restraint Systems (CSRSs), including car seats, arise. Many of these challenges are addressed in NHTSA's "Guideline for the Safe Transportation of Pre-school Age Children in School Buses" (February 1999).

Each pre-school age school bus passenger should use a child safety restraint system appropriate for the child's age, weight, height and specialized needs, as determined by the IEP. Thus, a team effort is required to ensure that appropriate and proper specifications are developed for the procurement of equipment that meet the specific needs of each individual school bus passenger.

The following Federal Motor Vehicle Safety Standards are applicable in this section:

*FMVSS No. 208 Occupant Protection*

*FMVSS No. 209 Seat Belt Assemblies*

*FMVSS No. 210 Seat Belt Assembly Anchorages*

*FMVSS No. 213 Child Restraint Systems*

*FMVSS No. 217 Bus Emergency Exits and Window Retention Release*

*FMVSS No. 222 School Bus Passenger Seating and Crash Protection*

*FMVSS No. 225 Uniform Child Restraint Anchorages*

A. All CSRSs used in the school bus must

1. Meet requirements of FMVSS No. 213.
2. Be installed, cleaned, maintained and used according to the manufacturer's instructions.
3. Not be under a recall that recommends non-use of the CSRS.
4. Have all parts intact and in working order.
5. Must not have exceeded the manufacturer's assigned expiration date.

6. Be secured to a vehicle seat with a safety belt that meets FMVSS No. 209 or anchorages to meet FMVSS No. 225 or FMVSS No. 210; and
7. Use safety belts or latch systems that are installed only on bus seats that meet FMVSS No. 210.
8. Be replaced when occupied during a school bus crash as specified by the manufacturer of the CSRS.

## B. Child Safety Restraint Systems (CSRSs)

CSRSs used in school buses must be appropriate for the individual child and must be used correctly. All of the restraint systems used for transportation must be secured to the bus seat in the manner prescribed and approved by both the school bus and CSRS manufacturer.

### 1. Elements of Correct Installation of CSRSs

It is recognized that compartmentalization, the passive safety restraint system required in school buses under FMVSS No. 222, provides a higher level of safety to children over 40 pounds. Children diagnosed with medical complexities or fragility might require special securement or positioning systems.

#### a. Direction

Position (rear- or forward-facing) and adjust recline angle accordingly. Some rear-facing seats are designed for rear-facing only and may not be used in a forward-facing position. (Check manufacturer's instructions.)

#### b. Belt Paths and Harness Strap Location

Use the correct belt path and harness strap slots on the CSRS as directed by the manufacturer's instructions.

**Note:** Heavy coats should be removed to ensure a tighter fit.

#### c. Installation

To achieve tight installation, place hand on and push down in the CSRS to compress the bus seat cushion. With the buckle(s) engaged, pull the loose end of the seat belt(s) to tighten and lock the safety belt. The CSRS should not move more than one inch forward or side-to-side when tested by grasping the seat at the belt path.

### 2. Types of Restraints