

Optimizing Child Protection in School Buses

Delegates of the Canadian Pupil Transportation Conference held in Ottawa last May were privileged to attend a special plenary session on the topic of “**Optimizing Child Protection in School Buses**” presented by Transport Canada’s Suzanne Tylko. As Chief of Crashworthiness Research with Transport Canada’s Road Safety Directorate, Ms. Tylko is a leading expert in her field of crash testing and occupant protection research. She graduated from the University of Alberta with a BSc. in nursing followed by a BSc. in mechanical engineering. She has lead numerous studies into frontal crash protection, side impact protection and child restraints. She has initiated a study of side impact protection on school buses and conducted the first ever full scale motor coach tractor trailer crash at Transport Canada’s research facility in Blainville, Quebec.

The presentation began by putting into perspective the safety performance of the school bus in relation to other motor vehicles. Statistics from the Traffic Accident Injury Database and data collected by collision investigation teams across Canada show just how safe school bus transportation is. For example, in Canada about 30,000 people are injured annually in motor vehicle collisions, of which less than 300 are school bus passengers. The safety performance of the school bus is undeniably superb; however, Transport Canada continues to examine school bus collisions and injuries with a view to making improvements where feasible while being careful not to compromise the effectiveness of the current occupant protection system.

Transport Canada’s analysis of school bus crash types shows that about 50% of school bus occupant injury accidents involve frontal or rear impact. About 23% involve a rollover, 20% involve a side impact and 4% of injuries are due to vertical displacement of the passenger. The current “passive” protection system (comprised of thickly padded and closely spaced seats, high seatbacks, and smooth interior surfaces) is proven to be very effective in the most common collision types – frontal and rear impacts. However, a review of serious injury rates between 1992 and 2009 shows that the most serious injuries involve side impact, rollover and vertical displacement type crashes which points to the need for research to address the feasibility for improvements in this area. A review of the eight school bus passenger fatalities in Canada between 1992 and 2009 shows that side impact accounted for five of the eight fatalities.

Transport Canada is researching ways to address injuries associated with side impacts and ejections from the seating compartment during rollovers or vertical displacement. The three countermeasures being studied are: three point seat belts, lap belts and improved compartmentalization through sidewall padding and inflatable side curtains. All three countermeasures are being examined from the perspective of:

- protection against ejection (in the case of seat belts)
- protection from impact in the case of padding and airbags
- unintended risk of injury from improper use or non-use of seat belts
- appropriateness for all age groups and all sizes of passengers
- practicality for users
- affordability

For example, in the case of three-point seat belts, the challenges include finding ways to strengthen the seat structure to withstand the loads applied by the belts, ensure the belts fit a wide range of passengers correctly and for the belts to be worn correctly. Sled testing conducted to date have shown that the stiffer seat backs pose a greater risk of head and leg injuries to unbelted passengers.

In the case of lap belts, the installation does not have to stiffen the seat backs and there are fewer issues with correct usage. Lap belts can help keep passengers within the seating compartment, however, research shows that risk of head and neck injury is greater than it is for unbelted passengers which is why to date, Transport Canada has recommended against the use of lap belts in school buses.

Transport Canada is looking into additional side structure padding, including energy absorbing foams as a possible countermeasure to reduce head injury risk from side impacts and is currently developing test methodology and appropriate injury criteria to aid in material selection.

Ms. Tylko's presentation also addressed the use of harnesses in school buses to increase protection in the case of frontal collisions for children who lack the size or muscle strength to benefit from compartmentalization. Research to date shows that harnesses attached to the seat back and seat cushion offer better restraint than harnesses attached only to the seat back. Testing with dummies shows that harnesses can help keep the dummy upright and in the seat, however harnesses don't significantly limit forward movement of the dummy in severe frontal crashes. Another concern that arose through harness testing is the extent of seat back deformation when a restrained dummy is seated in the row ahead of larger unrestrained dummies, compromising the occupant space.

Transport Canada's list of mid to longer term improvements for school bus occupant protection includes: improvements to seat design to improve containment; improved suspension design to reduce vertical displacement; side inflatable curtain (air bag) technology to prevent ejections; and investigate design concepts to enhance lateral containment.

Audience reaction and feedback to Ms. Tylko's presentation were extremely positive and delegates were impressed by the way she presented a very complex topic in a manner that made sense. Delegates gained a better appreciation for how effective the current school bus occupant protection system is, the intricate interrelationships between safety design features and how changing one element of the safety system can have unintended negative consequences in another area. In other words there is no "silver bullet" when it comes to improving upon an occupant protection system that has made the school bus the safest vehicle on the road. Seat belts are not necessarily the safety panacea that some believe and simply superimposing seat belts on the current school bus design could actually diminish overall school bus safety. More research needs to be done before Transport Canada will be in a position to recommend changes to the school bus manufacturing standards governing occupant protection.