

NORTH CAROLINA SCHOOL BUS CRASH DATA AND ISSUES RELATED TO SEAT BELTS ON LARGE SCHOOL BUSES

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School bus transportation and safety is a very serious and sometimes controversial and emotional issue. Although school buses have been shown to be a very safe form of transportation, many parents and safety advocates question the absence of seat belts on school buses. Without a doubt, the issue of installing seat belts on school buses is very controversial. At the center of this debate are three fundamental issues:

1. Will seat belts on large school buses do more harm than good or could seat belts reduce at least some of the injuries that occur to occupants of crash-involved school buses?
2. If it is determined that installing seat belts on school buses would reduce injuries, would the injury reductions be sufficient to justify their cost?
3. If school buses are equipped with seat belts, what are the operational concerns that must be addressed?

Overview of Federal Standards for School Buses

Parents and others concerned with the lack of seat belts on school buses must remember that these vehicles are covered by standards separate, and much different, from those covering passenger cars. After a series of crash tests with different seating configurations and much study and debate, the National Highway Traffic Safety Administration (NHTSA) issued a set of Federal standards targeting the safety of school buses that went into effect April 1, 1977.

Among the three major federal standards that went into effect in 1977 was FMVSS 222, School Bus Passenger Seating and Crash Protection. Whereas passenger cars, light trucks and vans are required to have seat belts at all designated seating positions, FMVSS 222 does not require the installation of seat belts (other than for the driver) on new school buses with gross vehicle weight ratings (GVWRs) of greater than 10,000 pounds, the standard large school bus. Buses with GVWRs of 10,000 pounds or less are required to have seat belts for all passenger positions, but the larger buses rely on strong, well-padded, energy absorbing seats and higher seat backs to "compartmentalize" and protect passengers during a crash.

Subsequent testing and case studies of school bus crashes have found compartmentalization to be effective in protecting school bus passengers in frontal crashes. Even so, the debate about the pro's and con's of installing belts on buses continues, in large part due to the contention that the potential for injuries and fatalities to unrestrained school bus passengers in side impact and rollover collisions is a compelling reason to require seat belts in large school buses.

Seat Belts on School Buses: Two Sides of the Argument

The Case FOR Seat Belts on School Buses

Advocates of belts on buses offer the following arguments in support of requiring belts on buses:

- Advocates of belts on buses interpret available crash-test and case-study data as indicating that belts provide improved crash protection and are beneficial especially in side-impacts and roll-overs.
- Use of seat belts can provide a reduction in injuries to out-of-position students kept in their seats by seat belts.
- Use of seat belts can lead to improvements in passenger behavior and distractions to drivers.
- Use of seat belts in school buses will help to reinforce seat belt educational messages aimed at school-age children with the carry-over effect helping to remind children to use seat belts in cars.

The Case AGAINST Seat Belts on School Buses

Opponents of belts on buses offer the following arguments against requiring belts on buses:

- School bus collisions that result in death or serious injuries are often catastrophic crashes involving large trucks or trains where belts would not help.
- For less severe crashes, opponents of belts on buses interpret the same available crash-test and case-study data as indicating that seat belts are harmful and thus argue that belts decrease crash protection since jackknifing of the students' bodies over the belts targets the head into the back of the seats in front of them.
- Evacuation of the bus in case of fire could be hampered by belted occupants.
- Installation of seat belts does not guarantee use by students. The need for drivers to monitor belt use would increase, rather than decrease distractions.
- There are no Federal standards covering the installation of seat belts on large school buses.
- Sharing of buses by different schools means that belts would be used by very different sizes of children leading to difficulties of assuring a correct fit for all students.

Transportation Research Board Comprehensive 1989 Study

To address the question of school bus safety in general, and the issue of seat belts in particular, the U.S. Congress asked the Department of Transportation to contract with the National Academy of Sciences to conduct a comprehensive study of the principal causes of fatalities and serious injuries to children riding in school buses, the use of seat belts in school buses, and other measures that may improve the safety of school buses. As a result of this directive, the Transportation Research Board of the National Research Council conducted such a study and issued the report *Improving School Bus Safety* in 1989 [National Research Council, Transportation Research Board (1989). *Improving School Bus Safety: Special Report 222*. Washington, DC].

As a result of this in-depth study, based on analyses of crash-test data and school bus crash case studies, the panel convened to produce the report concluded that seat belts can indeed provide additional crash protection on "compartmentalized" school buses. They further concluded that:

If all Type I school buses operated in the United States were equipped with seat belts, one life might be saved and several dozen serious injuries avoided each year. On the basis of this estimate, the committee concludes that the overall potential benefit of requiring seat belts on large school buses is insufficient to justify a federal standard mandating installation. The funds used to purchase and maintain seat belts in the nation's fleet of school buses--more than \$40 million/yr-- might better be spent on other school bus safety programs and devices to save more lives and reduce more injuries.

It should be noted that the results and recommendations of this report have at times been either misinterpreted or misstated. This study did not conclude that seat belts do more harm than good and therefore should not be installed on buses. On the contrary, the committee concluded that belts would do more good than harm, but the cost-benefit analysis precluded making a recommendation for universal installation. As shown by national statistics, most school-bus-related fatalities and serious injuries are either occupants of other vehicles or occur at the bus stop as students are getting on or off. For this reason the committee recommended that funds that would be used to install seat belts on buses would be better used to address non-occupant fatalities and injuries. This assumes, of course, that funds are available and would be used to address these other issues.

National Highway Traffic Safety Administration (NHTSA) School Bus Safety Research Plan

As has been previously noted, the primary means of occupant protection for large school buses is compartmentalization -- strong, well padded, well anchored, high backed, evenly spaced seats. Even though compartmentalization has been shown to be a good concept for injury reduction, NHTSA has initiated a research program to develop the next generation of occupant protection for school bus passengers.

This comprehensive program will evaluate alternative occupant crash protection systems in controlled laboratory tests that represent the types of real world school bus crashes that produce injuries to passengers. A key component of this program will be a thorough search for better crash data. Existing state and school systems records will be searched for documentation on school bus crashes involving fatalities and injuries and specific crashes in which seat belts were used. Those crash data will be vital to defining the test conditions that best simulate the most injurious school bus crashes. Alternative occupant restraint systems will be tested and evaluated for their ability to protect the full range of bus occupants without unduly reducing occupant capacity of the bus or restricting emergency egress. If it is determined that

all these criteria can be met, NHTSA will consider upgrading its occupant protection standards. The outline and schedule for completion of this effort follows:

Phase I: Problem Definition (to be completed by February, 1999)

- Analyze existing Department of Transportation databases including the Fatal Analysis Reporting System, General Estimates System, and National Automotive Sampling System for school bus crash information and corresponding injury data.
- Perform literature search for existing school bus related crash and occupant protection research.
- Issue Federal Register notice asking public for input on school bus occupant protection systems that should be tested and crash pulses that should be used. Perform in-depth special investigations of existing state and school system records on bus crashes involving fatalities/injuries and specific crashes in which seat belts were used.

Phase II: Test Procedure Development (to be completed by August, 1999)

- Develop test conditions that best simulate the most injurious school bus crashes identified through Phase I research.
- Develop crash pulses by conducting full scale school bus crash testing at various impact angles.
- Develop and validate sled test procedures using the derived crash pulses. Design and if necessary manufacture new occupant protection systems and/or incorporate new components or changes into existing systems.
- Conduct preliminary tests to verify the systems prior to final sled testing.
- Design sled test matrix to evaluate the new or altered occupant protection systems.

Phase III: Testing and Validation (to be completed by June, 2000)

- Test the various safety systems developed /identified. Conduct both static (i.e., FMVSS 222) and dynamic (new sled test procedure) tests.
- Analyze test results.
- Produce final report.

Transportation of Pre-school Age Children in School Buses

As more pre-school age children are transported to school programs, often in school buses, the public is increasingly asking the National Highway Traffic Safety Administration (NHTSA) about how to safely transport them. To help answer these questions, NHTSA conducted crash testing of pre-school age size dummies in school bus seats. The test results showed that pre-school age children in school buses are safest when transported in child safety restraint systems

(CSRSs) that meets FMVSS 213, Child Restraint Systems, and are correctly attached to the seats.

Based on its research, NHTSA recommends pre-school age children transported in school buses always be transported in properly secured CSRSs. In partial response to questions from school (and child care) transportation offices, the NHTSA guidelines seek to assist school and other transportation managers in developing and implementing policies and procedures for the transportation of pre-school age children in school buses.

Note that the proper installation of CSRSs necessitates that a school bus seat have safety belts or other means of securing the CSRS to the seat. NHTSA recommends that lap belts or anchorages designed to meet FMVSS 225, Tether Anchorages and Child Restraint Anchorage Systems, be voluntarily installed to secure CSRSs in large school buses.

NHTSA Recommendations for the Transportation of Pre-school Age Children in School Buses
When pre-school age children are transported in a school bus, NHTSA recommends these guidelines be followed:

1. Each child should be transported in a Child Safety Restraint System (suitable for the child's weight and age) that meets applicable Federal Motor Vehicle Safety Standards (FMVSSs).
2. Each child should be properly secured in the Child Safety Restraint System.
3. The Child Safety Restraint System should be properly secured to the school bus seat, using anchorages that meet FMVSSs.

North Carolina School Bus Crash Statistics

In an effort to determine the extent of injuries sustained by school bus occupants in North Carolina, the UNC Highway Safety Research Center obtained school bus crash data contained in the NC Division of Motor Vehicles (DMV) accident files for the calendar years 1991 through 1997. The following table presents injury data only for school bus occupants in the NC DMV data. School bus drivers and riderless buses have been excluded. During this time period, there were a total of 3,689 buses, 358 activity buses and 3,331 school buses, involved in crashes. These crashes involved 59,038 occupants.

The injury statistics confirm that overall, students are well protected in these crashes with almost 90% receiving no injuries. The overall school bus fatality rate of 0.01% and serious injury rate of 0.06% compare very favorably with the fatality rate of 0.17% and serious injury rate of 1.73% for 5 to 15 year old occupants of passenger cars involved in North Carolina crashes during the time period 1992 through June 1998.

The crash and injury statistics do, however, indicate two areas of concern. One is the higher level of fatal plus serious injuries to occupants of activity buses (0.17%) when compared to

Injuries to Occupants of School Buses Involved in Crashes in North Carolina: 1991-1997
(Drivers and Riderless Buses Excluded)

Bus Type & Crash Type	# Buses		# Riders		Injuries*									
					Fatal		Serious		Moderate		Minor		None	
	#	%↓	#	%↓	#	%	#	%	#	%	#	%	#	%
<i>Activity Bus</i>														
Front/Rear	215	60.1	2,439	52.1	0	0.00	2	0.08	26	1.07	234	9.59	2,177	89.3
Rollover	13	3.6	180	3.8	1	0.56	3	1.67	36	20.00	89	49.44	51	28.3
Side/Other	130	36.3	2,065	44.1	0	0.00	2	0.10	9	0.44	136	6.59	1,918	92.9
Total	358	100	4,684	100	1	0.02	7	0.15	71	1.52	459	9.80	4,146	88.5
<i>School Bus</i>														
Front/Rear	2,117	63.6	35,527	65.4	0	0.00	4	0.01	13	0	3,594	10.12	31,916	89.8
Rollover	35	1.1	525	1.0	0	0.00	11	2.10	28	5.33	291	55.43	195	37.1
Side/Other	1,179	35.4	18,302	33.7	4	0.02	12	0.07	150	0.82	1,561	8.53	16,575	90.6
Total	3,331	100	54,354	100	4	0.01	27	0.05	191	0.35	5,446	10.02	48,686	89.6
<i>Total</i>														
Front/Rear	2,332	63.2	37,966	64.3	0	0.00	6	0.02	39	0.1	3,828	10.08	34,093	89.8
Rollover	48	1.3	705	1.2	1	0.14	14	1.99	64	9.08	380	53.90	246	34.9
Side/Other	1,309	35.5	20,367	34.5	4	0.02	14	0.07	159	0.78	1,697	8.33	18,493	90.8
Total	3,689	100	59,038	100	5	0.01	34	0.06	262	0.44	5,905	10.00	52,832	89.5

* Injuries based on the NC DMV injury scale where: "Fatal" = Killed; "Serious" = Incapacitating (injury serious enough to prevent carrying out normal activities for at least 24 hours, e.g., massive loss of blood, broken bone); "Moderate" = Non-incapacitating (injury other than killed or serious evident at the scene); "Minor" = No visible sign of injury but complaint of pain or momentary unconsciousness; "None" = No injury.

school buses (0.06%). The second area of concern is the injury rate for rollover and side impact crashes when compared to the front and rear impacts. The fatal plus serious injury rate for activity buses involved in rollovers is 2.23% compared to 0.08% for the front/rear impacts. For the school buses, the rollover fatal plus serious injury rate is 2.10% compared to 0.01% for the front/rear impacts.

This difference in injury rates is to be expected since compartmentalization is designed to provide protection primarily in frontal and rear end impacts can be used to support the argument that seat belts are needed for the side impacts and rollovers. On the other hand, the relatively rare rate of occurrence for rollover crashes (1.3% for all bus crashes) and the low number of injuries (15 fatal plus serious injuries out of 53,000 occupants) can be used to support the argument that the buses are safe enough without seat belts and safety improvements need to target injuries from other sources.

Issues to Address Relevant to the Issue of Seat Belts on School Buses

Based on the information that is known about the potential crash protection benefits of seat belts on large school buses, as well as installation and other operational concerns, there are a variety of issues related to requiring their required installation that should be addressed:

1. **FATALITIES AND SERIOUS INJURIES:** Compartmentalization has been shown to be effective in reducing injuries in frontal and rear-end crashes, the most common school bus crash types, and seat belts may have little or no effect in these crashes. NC data indicates that the injury rates for rollover and side impact crashes are much higher than for the frontal crashes, but the actual number of fatal and serious injuries are small. The essential question that must be addressed is if the number of injuries in rollovers and side impact crashes justify the cost of installing seat belts on school buses?
2. **EFFECTIVENESS OF EXPENDITURES:** It is argued that the safety record of school buses is already so good that the additional \$1,500 to \$2,000 cost per bus to install lap belts could be better spent on other safety measures that address injuries sustained around the bus while loading and unloading. If it is determined that choices must be made between increasing safety inside the bus vs. outside the bus, is there any guarantee that adequate funds will be made available and spent effectively to increase safety outside the bus?
3. **NO GUARANTEE OF USE:** Installing seatbelts in a school bus does not mean that students will use them. Is there justification in requiring the installation of seat belts if there is no requirement for their use?
4. **MONITORING:** Is it possible, and is it necessary, for the bus driver to monitor use and proper adjustment of seat belts? How could required use of belts be enforced?
5. **ASSIGNMENT OF SEAT BELT EQUIPPED BUSES:** If seat belts are required on school buses in North Carolina, either by state law or federal mandate, how should the new buses with belts be distributed within a school district? Should it be by following existing replacement policies or should the belt equipped buses be targeted in a systematic manner such as targeting elementary schools first?
6. **NO FEDERAL RECOMMENDATIONS OR STANDARDS:** There are currently no federal motor vehicle safety standards covering the installation of seat belts on large school buses nor are systems other than lap belts readily available. The National Highway Traffic Safety Administration is currently involved in a study addressing many of the issues involved and has announced that a report will be published in the year 2000. Would it be reasonable and desirable to address these issues after this report is concluded?
7. **CURRENT AND PLANNED TRANSPORTATION OF PRESCHOOL CHILDREN IN SCHOOL BUSES:** The National Highway Traffic Safety Administration (NHTSA) states that

pre-school age children in school buses are safest when transported in child safety restraint systems that meet FMVSS 213, Child Restraint Systems, and are correctly attached to the seats. Based on its research, NHTSA recommends pre-school age children transported in school buses always be transported in properly secured child safety restraint systems. To what extent are preschool children transported in school buses to what degree is the State of North Carolina following NHTSA recommendations for the transportation of preschool children?