

**TRANSPORTATION SCIENCES
CRASH RESEARCH SECTION**

**Veridian Engineering
Buffalo, New York 14225**

SCHOOL BUS CRASH

VERIDIAN CASE NO. CA98-040

**1994 INTERNATIONAL AMTRAN SCHOOL BUS
1995 INTERNATIONAL AMTRAN SCHOOL BUS**

LOCATION - NEW YORK

CRASH DATE - JULY 1998

Contract No. DTNH22-94-07058

Prepared for:

**U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, DC 20590**

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness of the involved vehicle(s) or their safety systems.

TECHNICAL REPORT STANDARD TITLE PAGE

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<p>17. <i>Abstract</i> This crash involving two school buses was reported to the Crash Investigations Division of the National Highway Traffic Safety Administration (NHTSA) by the National Response Center in July 1998. The Special Crash Investigations team at Veridian was subsequently notified by NHTSA and directed to conduct an on-site investigation with the objective of determining the effectiveness of the restraint belt systems with respect to injuries suffered by the children on the school buses. The Veridian crash reconstruction team was on-site the next day and evaluated both involved school buses and conducted interviews with drivers and occupants of both buses.</p>			
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**SCHOOL BUS CRASH
VERIDIAN CASE NO. CA98-040**

**1994 INTERNATIONAL AMTRAN SCHOOL BUS
1995 INTERNATIONAL AMTRAN SCHOOL BUS
STATE OF NEW YORK
JULY, 1998**

Background

This crash involving two school buses was reported to the Crash Investigations Division of the National Highway Traffic Safety Administration (NHTSA) by the National Response Center in July 1998. The Special Crash Investigations team at Veridian was subsequently notified by NHTSA and directed to conduct an on-site investigation with the objective of determining the effectiveness of the restraint belt systems with respect to injuries suffered by the children on the school buses. The Veridian crash reconstruction team was on-site the next day and evaluated both involved school buses and conducted interviews with drivers and occupants of both buses.

Crash Summary

A crash involving the front and rear of two fifty-four passenger yellow school buses occurred on a limited access, divided, 4-lane roadway in the late morning hour in the month of June, 1998 in the State of New York. The school buses were transporting 84 children, 11 teen age counselors, one parent chaperon, and 4 adult staff of a youth organization to a day event at an out-of-state park. The trip included travel on a scenic route which was restricted to automobile use only. The school buses, however, were allowed to use this roadway after obtaining a one-day special road use permit.

As the buses proceeded northbound on this scenic route, the lead school bus encountered a disabled vehicle in the right lane. The roadway in this area was divided with two travel lanes in each direction and bordered by curbs with no shoulder pull off access. The disabled vehicle was located in a straight segment of the roadway just beyond a right curved section.

The female driver of the disabled vehicle was reportedly out of her vehicle and warning traffic by waving vehicles over into the left lane. Apparently, a vehicle traveling several vehicles ahead of the lead school bus reacted late to her warnings and attempted to enter the left lane. It subsequently collided with another vehicle which had already moved into the left lane. These vehicles came to rest in the left lane beyond the disabled vehicle, effectively blocking the road..

The lead school bus, a 1995 International chassis with an AmTran bus body (Vehicle #2), was part of a five school bus convoy. The Driver #2, a 51 year old male, saw the warnings by the driver of the

disabled vehicle, but did not immediately observe the aforementioned crash. He changed lanes to the left and was following two other non-crash involved vehicles.

The second school bus in the convoy, a 1994 International chassis with an AmTran bus body (Vehicle #1), was traveling directly behind Vehicle #2 in the right lane. When Vehicle #2 changed the lanes, Driver #1, a 40 year old male, followed suit.

As Vehicle #2 approached the disabled vehicle, Driver #2 observed that the crash vehicles were blocking the left lane. Driver #2 applied the brakes and avoided a collision with the two vehicles in front of his bus which had already stopped behind the crash vehicles. When Driver #1 saw the lead vehicle apply the brakes he responded by applying full brakes. The driver indicated that he also reached down and engaged the manual parking brake in an effort to avoid the crash.

Vehicle 1 - 1994 International Amtran School Bus Damage

The front of Vehicle #1 (refer to **Figures 1-2**) struck the rear of Vehicle #2 (resulting in an estimated delta V of 16-24 km/h (10-15 mph). Contact on Vehicle #1 extended across the entire front of the vehicle and was assigned an equivalent Truck Deformation Classification (TDC) of 12-FDEW-1 (school buses are not classifiable under current SAE deformation guidelines). The maximum crush on the front bumper measured 9.5 cm (3.75") which was located at the right front bumper corner. The vehicle sustained damage to the radiator which resulted in the vehicle being towed from the scene.



Figure 1
Frontal view of Vehicle #1



Figure 2
View of the left side illustrating the damage.

Vehicle 2 - 1995 International Amtran School Bus Damage

Vehicle #2 sustained contact damage across the entire rear plane with the maximum crush of 11.4 cm (4.5") which was located 88.9 cm (35.0") right of the left bumper corner. An equivalent Collision

Deformation Classification (CDC) of 06-BDEW-1 was assigned. This vehicle was driven from the scene to the bus company's parking lot (refer to **Figures 3-4**).



Figure 3
View of the left rear corner of Vehicle #2, struck school bus

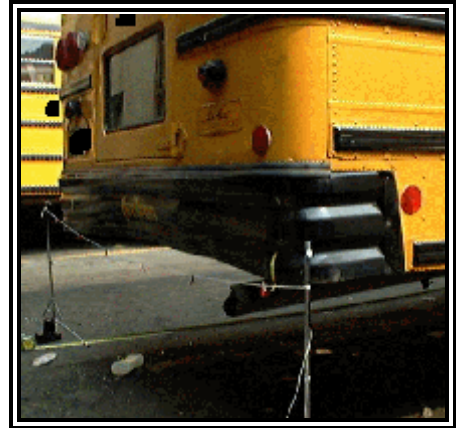


Figure 4
Close-up view of the damage to the rear plane of Vehicle #2

Occupants and Restraints

The school buses had a 54 passenger seating capacity. Vehicle #1 was transporting 39 children, 2 staff members, and 6 teen age counselors for a total of 47 passengers. Vehicle #2 was transporting 45 children, 2 staff members, 1 parent chaperon, and 5 teen age counselors for a total of 53 passengers. There were 11 seat rows in each bus with left side seats having three designated seating positions and the right side having two designated seating positions (refer to **Figure 5**). The last row on the left side of the bus had only two designated seating positions.

The high back seat designed measured 74.9 cm (29.5") above the seat cushion. The leading edge of the seat cushion was 39.4 cm (15.5") above the floor while the rear edge was 33.0 cm (13.0") above the floor (refer to **Figure 6**). The lateral dimension of the seat cushion was 112.4 cm (44.25") on the left side and 76.2 cm (30.0") on the right. The lateral width of the bus measured 229.2 cm (90.25") and the rubberized surface of the walk aisle measured 34.3 cm (13.5") wide.



Figure 5
View of the interior of Vehicle #1 looking from the front to the back



Figure 6
View of the seat profile, row 9, Vehicle #2

Each seat position was equipped with a color coded lap belt. The left side rows had a red belt in the outboard seat position, a blue belt in the center seat position, and a brown belt in the inboard (aisle) position. The right side rows had a blue lap belt in the outboard seat position and a brown belt in the inboard (aisle) seat position (refer to **Figures 7-8**).



Figure 7
View of lap belts on left side of bus



Figure 8
View of lap belts on right side of bus

Seventeen people which included twelve children, four adult staff members, and one counselor from the two buses were transported via ambulances to two local hospitals. They were treated and released approximately six hours after the crash. Five of the children transported were occupants in Vehicle #1 (striking vehicle) and seven were from Vehicle #2 (struck vehicle). Two staff members and one teen age counselor were in Vehicle #1 and two staff members were occupants of Vehicle #2.

According to both drivers and staff members, of the five children transported in Vehicle #1 (striking bus) only three children appeared to be injured in the crash. An unrestrained 11 year old girl reportedly moved forward and struck her head on the seat back support of the seat in front of her. A staff member indicated that she appeared to be dazed immediately following the crash. A 10 year old male reportedly sustained a laceration of the lip as the result of biting his lip during the crash. Another 10 year old boy sustained an unspecified injury to his left eye from contact with the side panel of the bus. The other two children apparently were responding to repeated injury inquiries by the youth organization staff, police, and rescue and claimed back and neck pain. These children reportedly were later diagnosed as not injured at the hospital.

In Vehicle #2 (struck bus), one child was diagnosed with hematuria which was determined to have resulted from a contused kidney. He was scheduled for additional testing the week following the crash. The other children complained of head and neck pain. The youth organization staff, however, was doubtful that many of these children were indeed injured. They cited one example where one male child was running around the hospital where hospital personnel and staff members had to repeatedly chase after him in order to exam him.

Two unrestrained male staff members seated in the first row of Vehicle #1 sustained minor injury in the crash. The 20 year old male who was 200.7 cm (79.0") tall and weighed 97.5 kg (215) was sitting sideways on the left seat between the outboard and center seat positions with his feet toward the center aisle. He moved forward during the crash and contacted the modesty panel with his left shoulder. He suffered pain of the left shoulder as the result of this contact mechanism. The 19 year old male who was 193.0 cm (76.0") tall and weighed 99.8 kg (220 lbs.) was sitting sideways on the right side of the bus and occupying the two available seat positions. His feet were oriented toward the center aisle. He sustained swelling of the right knee after contacting the modesty panel during the crash. Radiography of the knee was negative.

A pregnant teenage counselor in Vehicle #2 was sitting with a female child occupant who was resting her head on the counselor's lap. The head of the child reportedly contacted the counselor's abdominal area which resulted in pain. The counselor was transported to the hospital and observed as precautionary measure. There were no abnormalities noted.

A 26 year old female staff member in Vehicle #2 was sitting in the fifth row in the inboard seat and not using the lap belt. She suffered neck and back pain and was transported to the hospital.

The exact seating location of every child and some of the counselors was not readily available from the youth organization. The organization appeared to be very cautious and at times provided limited cooperation with certain aspects of this investigation, in particular with the seating issue. They repeatedly emphasized the fact that every child was restrained by the lap belt. Counselors and children were prohibited from discussing the crash unless parental permission was obtained.

Additionally, there were conflicting statements regarding the use of seat belts by the children. The youth organization indicated that all children were restrained by the lap belts before the buses departed the parking lot. One person indicated that the belts were reviewed for usage and adjusted accordingly to properly fit the child by three separate people before the trip started. Another person indicated that the belt usage review process could not be completed because the bus began the trip shortly after everyone boarded the vehicle. The school bus driver for Vehicle #1 indicated that the children were standing up in the rear of the bus. He claimed that some of the children were thrown forward in the aisle during the crash.

Inspection of the lap belt systems in both buses indicated that several lap belts (particularly in Vehicle #1) were either not available (i.e., a portion of the belt was buried under the seat) or the latch plate was extended to the outer limit of the belt thereby rendering the belt ineffective if worn **Figures 9 and 10** are typical views of the condition of the seat belts. **Figures 11 and 12** are schematics of the respective buses documenting the inspected condition of the seat belts. Many of the children injured in Vehicle #1 were located in the rear seat rows where many belts were either not accessible or not worn.



Figure 9
View of row 5 left side in Vehicle #1 showing inboard and outboard lap belt buckles were not visible



Figure 10
View of row 2 in Vehicle #1 showing the outboard and center lap belts adjusted to the maximum length

The school bus seating arrangement was divided by age and arranged by groups. Vehicle #1 consisted of two groups with 17 children (ages 9-12) in Group 1 and 22 children (ages 10-12) in Group 2. Group 1 loaded the bus first and were seated in the rows 6-10. Row 11 (the last row) was occupied by three counselors. Group 2 occupied rows 2-7 (rows 6 and 7 had some overlap of groups) with two staff members occupying the front row.

The injured children in Vehicle #1 were located as follows:

- C Row 3, left side, center seat, 10 year old male, may not be restrained (portion of outboard red belt was latched into center blue belt, laceration of the lip,
- C Row 8, left side, outboard seat, 10 year old boy, not restrained due to belt being adjusted to maximum length, injured left eye injury
- C Row 9, left side, center seat, 11 year old female, not restrained (per interview), injured head
- C Row 6-10, unknown seat location, 2 females, unknown if restrained, restraint belt tucked into seat in row 7 right side inboard, restraint belt tucked into seat in row 8 both right side seats, restraint belt tucked into seat in row 9 left side outboard, row 10 right side outboard

Vehicle #2 transported children in three groups which ranged in age from 6-9. Group 1 consisted of 14 children (ages 6-7) who were seated in rows 8-10. Group 2 also consisted of 14 children (ages 6-7) who were seated in rows 5-7 with some overlap in row 8. Group 3 was made up of 17 children (ages 7-9) who occupied rows 2-4 with some overlap in row 5.

The injured children in Vehicle #2 were located as follows:

- C Row 2-5, unknown location, 1 female, unknown injury, restrained
- C Row 5-8, unknown location, 2 female, unknown injury, restrained
- C Row 8-10, left side, unknown seat location, three six year old males (one boy suffered a bruise of the kidney), one six year old female, unknown injury, restrained

Several interviewed people indicated that the police and rescue arrived within five minutes of the crash. The police boarded the buses and attempted to identify the injured. A few children from each bus reportedly were identified and taken off the bus. They were held in a designated waiting area on the grass adjacent to the roadway. As the result of alleged prodding by others on the buses, more children came forward and indicated that they were injured. They then joined the group in the designated waiting area. Six ambulances arrived on-scene and transported the injured to two area hospitals.

The police indicated that upon their arrival, the scene was very chaotic. As a result, they were unable to identify all the occupants in the buses. Their investigation was continuing at the time of this publication.

Due to the high volume (normal) traffic on this roadway and the lack of shoulders, traffic was halted for over two hours while the injured were transported to medical facilities and the vehicles were removed. The buses were inspected by the New York State Police and the New York State Department Of Transportation with no safety defects detected.

Figure 11 LAP BELT RESTRAINT EVALUATION

Vehicle 1
Striking vehicle

RESTRAINT EVALUATION

28 of 54 lap belts
were unavailable

NU = belt not used,
latch plate at max.
adjustment

* = Buckle not visible

= Latch plate not visible

** = not used, outboard latch
plate buckled in
center buckle

? = belt length
appeared long

& = not used, belt
tucked in seat
cushion



											
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Figure 12 SEAT BELT EVALUATION VEHICLE #2

Vehicle 2
Struck vehicle

RESTRAINT EVALUATION

9 of 54 lap belts
were unavailable

NU = belt not used,
latch plate at max.
adjustment

* = Buckle not visible

= Latch plate not visible

** = not used, outboard latch
plate buckled in
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? = belt length
appeared long

& = not used, belt
tucked in seat
cushion

@ = twisted belt, not used
or improper use

