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REMOTE SCHOOL BUS INVESTIGATION

CASE NUMBER - IN99-077
LOCATION - TEXAS
VEHICLE - 1993 INTERNATIONAL 3700 WITH BLUEBIRD BODY
CRASH DATE - October, 1996

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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 performance of the involved vehicle(s) or their safety systems.

Technical Report Documentation Page

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15. *Supplementary Notes* Remote school bus investigation involving a 1993 International 3700 FBC bus chassis with a Bluebird school bus body, with driver only safety belt, and a 1989 Chevrolet Cheyenne, ¾-ton, 4x2, conventional cab pickup truck			

16. *Abstract*

This report covers a remote investigation of a school bus crash that involved a 1993 International 3700 school bus (case vehicle) and a 1989 Chevrolet Cheyenne 2500 pickup truck (other vehicle). This crash is of special interest because the case vehicle was a school bus equipped with an on-board video camera that recorded passenger kinematics in a crash that resulted in minor injuries to eight student occupants. The case vehicle had been traveling west in the westbound lane of a two-lane, undivided, city street and had approached a four-leg, offset-cross intersection. After stopping at a STOP sign, the case vehicle's driver turned left. The Chevrolet pickup was traveling north on a slight right-hand curve in the inside, northbound lane of a four-lane, undivided, city street and was approaching the same intersection. The driver of the case vehicle attempted to increase his acceleration to clear the northbound lanes; the driver of the Chevrolet pickup steered toward the outside, northbound lane and braked. The crash occurred between the northbound lanes within the intersection of the two roadways. The left back of the case vehicle (i.e., at the left rear wheel well and rear axle area) was impacted by the front left of the Chevrolet pickup. The case vehicle's driver (46-year-old male) was seated with his seat track located between its middle and rearmost positions, and it is unknown if the case vehicle was equipped with a tilt steering wheel. He was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. The driver's lap-and-shoulder belt was the only active restraint available in the case vehicle. He sustained, according to his interview, a minor abrasion to his left ring finger. Seating for the case vehicle's passengers consisted of 11 rows of bench seats rated for three occupants each, with the exception of the back left seat that was rated for two occupants. The bench seats were not adjustable. There were three adult (females, ages: 52, 44, and unknown) and 24 student passengers (one 9-year-old male, four 9-year-old females, nine 10-year-old males, six 10-year-old females, three 11-year-old males, and one 11-year-old female) on the case vehicle. The passengers were protected by the bus's passive restraint system (i.e., compartmentalization). None of the three adult passengers were injured. Of the 24 student passengers, eight sustained minor soft tissue injuries (i.e., bumps and bruises, but no bleeding).

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This remote investigation was brought to NHTSA's attention on November 9, 1998, by this SCI contractor. This crash involved a 1993 International 3700 school bus (case vehicle) and a 1989 Chevrolet Cheyenne 2500 pickup truck (other vehicle). The crash occurred in October, 1996, at 1:10 p.m., in Texas, and was investigated by the applicable city police department. This crash is of special interest because the case vehicle was a school bus equipped with an on-board video camera that recorded passenger kinematics in a crash that resulted in minor injuries to eight student occupants; however, a copy of the video tape was never provided to this contractor. This contractor obtained police photographs in October 1999, and interviewed the case vehicle's driver in November 1999. This report is based on the Police Crash Report; interviews with the case vehicle's driver, the school district's assistant superintendent, and the school district's director of transportation; police photographs; medical and self-reported injury information, occupant kinematic principles; and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle had been traveling west in the westbound lane of a two-lane, undivided, city street and had approached a four-leg, offset-cross intersection (**Figure 1**). After stopping at a STOP sign (Manual on Uniform Traffic Control Devices, R1-1), the case vehicle's driver turned left, intending to travel southward on the intersecting roadway (**Figure 2**). The Chevrolet pickup was traveling north on a slight right-hand curve in the inside, northbound lane of a four-lane, undivided, city street and was approaching the same four-leg, offset-cross intersection, intending to continue in its northerly travel path (**Figure 3** below). Noticing the approach of the Chevrolet pickup, the driver of the case vehicle attempted to increase his acceleration to clear the northbound lanes. According to the Police Crash Report, the driver of the Chevrolet pickup steered toward the outside, northbound lane and braked, attempting to avoid the crash (i.e., steering was negated by locked wheel braking). The crash occurred near the lane line that separates the two northbound lanes, within the intersection of the two roadways; see police **CRASH DIAGRAM** below.

Figure 1: Case vehicle's westbound approach on east leg of four-leg, offset-cross intersection; Note: both vehicles at final rest (i.e., other vehicle is white Chevrolet pickup) and regulatory STOP sign at upper right of photograph (case photo #01)

Figure 2: Southwestward view for case vehicle's driver of south leg of intersection showing potential view obstructions (case photo #03)

The left back of the case vehicle (i.e., at the left rear wheel well and rear axle area–**Figures 4** and **5** below) was impacted by the front left of the Chevrolet pickup (**Figures 6** and **7** below). The case vehicle was not equipped with any supplemental restraint systems (air bags). Based on

available information, the case vehicle continued southwestward, while rotating only slightly counterclockwise and came to rest near the point of impact heading south. The Chevrolet pickup rotated counterclockwise before coming to rest near the point of impact heading northwest.

Figure 3: Chevrolet pickup's northward travel path from inside to outside northbound travel lanes; Note: case vehicle present but pickup not seen in photograph (case photo #04)

CASE VEHICLE

The 1993 International 3700 was a rear wheel drive, 4x2, Flat Back Cowl bus chassis with a 66-passenger Bluebird school bus body attached (VIN: 1HVBAZRN7PH------). The case vehicle had a 7.3L, 447 CID, Navistar diesel engine and was equipped with power steering. The type of transmission and the location of the shift lever are not known, but a five-speed manual was standard with optional six- and seven-speed manual transmissions or a four-speed automatic. The case vehicle was equipped with dual air brakes but not anti-lock brakes. The case vehicle's wheelbase is unknown [range: 386-701 centimeters (152-276 inches)]. No odometer reading was reported.

Direct damage to the case vehicle included sheet metal crush forward, around, and aft of the left rear wheel well (**Figure 4**). In addition, the left rear dual wheels were knocked off their mounts and shoved to the rear; the left rear springs were broken at their forward connection; and the drive shaft was broken at a universal joint (**Figure 5**).

Figure 4: Damage to case vehicle's left rear wheel well and axle: Note: rearward displacement of left rear dual tires and disconnected drive shaft (case photo #10)

Figure 5: Forward end of case vehicle's broken left rear leaf springs; Note: Chevrolet pickup's contact marks on top leaf spring and on outside left rear dual tire (case photo #12)

Indirect damage consisted of the rear axle being angled, with the left rear dual wheels displaced rearward and the right rear dual wheels shoved forward. The investigating officer did not take any interior photographs of the case vehicle. There was no report of passenger compartment integrity loss or any indications of intrusion. The front right accordion door and the back emergency door remained closed and operational. Of the 12 left side windows, 6 were completely open, 3 were partially open, and 3 were closed. Of the 12 right side windows, 6 were completely open, 2 were partially open, and four were completely closed. The case vehicle (school bus) is not a NASS CDS-applicable vehicle and, therefore, the Collision Deformation Classification (CDC) is not applicable. The Truck Deformation Classification (TDC) is also not relevant. The case vehicle was towed due to disabling damage.

Figure 6: Chevrolet pickup's damaged front; Note: primary damage to front left corner and leftward shift of hood and right fender (case photo #15)

Figure 7: Chevrolet pickup's frontal damage viewed from left; Note: position of left front tire and induced damage to the left "A"-pillar (case photo #16)

The case vehicle's driver reportedly had a pedestal seat, with an available, active, three-point, lap-and-shoulder, safety belt system. Seating for the case vehicle's passengers consisted of 11 rows of bench seats rated for three occupants each, with the exception of the back left seat that was rated for two occupants. None of the passenger seats were equipped with safety belts.

CASE VEHICLE DRIVER

Immediately prior to the crash, the case vehicle's driver [46-year-old, White (non-Hispanic) male; 180 centimeters and 127 kilograms (71 inches, 280 pounds)] was seated in an upright posture with his back against the seat back, his left foot on the floor, his right foot on the accelerator, and both hands on the steering wheel. His seat track was located between its middle and rearmost positions, the seat back was upright and not adjustable, and he was uncertain if the case vehicle was equipped with a tilt steering wheel (i.e., the case vehicle was not his regularly assigned vehicle).

The case vehicle's driver was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. The driver's lap-and-shoulder belt was the only active restraint available in the case vehicle. He reported no evidence of belt pattern bruising and/or abrasions to himself.

As the case vehicle was entering the intersection from a stop, the case vehicle's driver was accelerating and steering left at the beginning of his left-hand (southward) turn and, thus, his pre-impact body position was likely leaning slightly to his left (i.e., into his turn). In an attempt to avoid the collision, the driver accelerated as he was attempting to complete the left-hand turn. Thus, his pre-impact body position was most likely normal or leaning slightly to his right. The case vehicle's impact with the Chevrolet pickup enabled the case vehicle's driver to move forward and leftward. The driver pivoted in his seat to the left, loading his safety belt. At final rest he was still sitting in the driver's seat, leaning to his left.

DRIVER INJURIES

The case vehicle's driver refused transport by ambulance to a medical facility, even though he sustained a minor injury. He was later transported in a local transit bus to a medical facility, along with the three uninjured adults, the one 9-year-old injured female who had refused transport in an ambulance, and 18 uninjured students, for precautionary examinations. The injury sustained by the case vehicle's driver was an abrasion {scrape} to the knuckle of his left ring finger.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasion {scrape} knuckle of left ring finger	790202.1 minor	Other front object: fan	Probable	Interviewee (same person)

CASE VEHICLE PASSENGERS

Pre-impact postures are unknown for the case vehicle's three female adults and 24 student passengers (i.e., one 9-year-old male, four 9-year-old females, nine 10-year-old males, six 10-year-old females, three 11-year-old males, and one 11-year-old female; ethnicity unknown for all, except as noted below); however, all were seated in bench seats rated for three occupants each. The bench seats had no tracks, and the bench seat backs were not adjustable. The case vehicle's seating area had 11 rows of seats on each side of the aisle, with the back left bench seat rated for only two occupants. Because the case vehicle was on a field trip, no assigned seating was in force, and the applicable school corporation made no record of the passenger seat locations when they viewed the on-board video tape. This contractor could not identify occupied seat locations (except for two), pre- or post-crash, or describe actual occupant kinematics because a copy of the case vehicle's video tape was never provided to this contractor.

The three adult (ages: 52, 44, and unknown; ethnicity unknown; all female) and 24 student passengers on the case vehicle were unrestrained, because the case vehicle was not equipped with safety belts other than for the driver; however, the passengers were protected by the bus's passive restraint system (i.e., compartmentalization). There were no photographs taken by investigating officers of the case vehicle's interior.

The pre-impact body position of the case vehicle's three other adults and 24 children is unknown (except for two), but it is likely that they too leaned slightly to the right just prior to impact. The case vehicle's impact with the Chevrolet pickup enabled the case vehicle's 27 passengers to move forward and leftward. It is unknown how many adults or children were tossed from the right-side seats towards the center aisle or into the left-side seats. In addition, post-impact positions of the adults and student passengers are not known.

The parents of two injured student passengers agreed to cooperate in this research. One passenger [9-year-old, White (non-Hispanic) female; unknown height and weight at time of crash], who was in the window seat on the left side of the seventh row, was seated in an upright posture with her back against the seat back, both feet hanging down over the front edge of the seat (i.e., her feet could not reach the floor), her left arm resting along the window glazing, and her right arm on her lap. The other passenger [10-year-old, White (unknown if Hispanic) female; 152 centimeters and 48 kilograms (60 inches, 105 pounds) at time of crash], who was in the aisle seat on the right side of the ninth row, was seated sideways–turned toward the center aisle (most likely), with both feet on the floor, and both hands on her lap.

PASSENGER INJURIES

According to the case vehicle's driver and the Police Crash Report, the three adult passengers were not injured, and eight of the case vehicle's 24 student passengers sustained only minor injuries (i.e., bumps and bruises, but no bleeding,) as a result of this crash. Seven of the eight injured students were transported by ambulance to a medical facility. One injured student, a 9-year-old female, refused transport by ambulance to a medical facility, but later accompanied the other uninjured passengers to a medical facility.

For the two families that agreed to cooperate in this research, the 9-year-old female was transported by ambulance to the hospital. She sustained minor injuries and was treated and released. She sustained, according to her medical record, a contused forehead from contacting the side window glazing, including the frame and/or sill. The 10-year-old female was transported by ambulance to the hospital. She sustained a minor soft tissue injury (i.e., contusion) to her back and was treated and released.

CASE VEHICLE 7TH ROW LEFT WINDOW PASSENGER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion left forehead	290402.1 minor	Left side window glazing including frame and/or sill	Probable	Emergency room records

CASE VEHICLE 9TH ROW RIGHT AISLE PASSENGER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion back, not further specified	690402.1 minor	Seat back support	Possible	Other: completed questionnaire

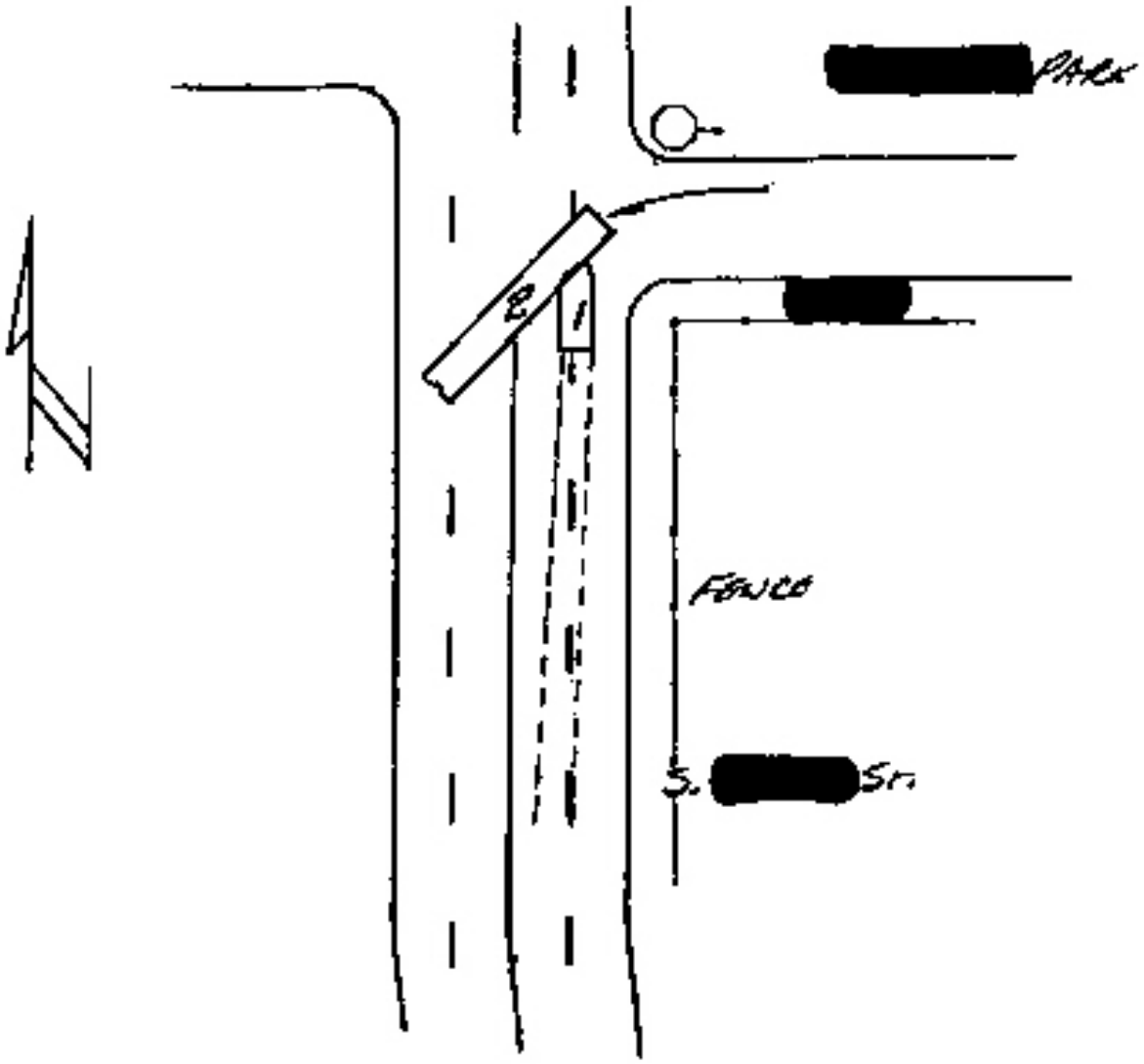
OTHER VEHICLE

The 1989 Chevrolet Cheyenne 2500 was a rear wheel drive, three-quarter-ton, 4x2, three-passenger, two-door, conventional cab, pickup truck (VIN: 1GCFC24K6KZ------) equipped with a 5.7 liter, V-8, EFI, gasoline engine, power steering, and a four-speed automatic transmission with a steering column-mounted shift lever. This vehicle was equipped with vacuum powered hydraulic front disc and rear drum brakes, but not anti-lock brakes. Its wheelbase was 334 centimeters (131.5 inches). No odometer reading was reported. The Chevrolet pickup had an estimated 907 kilograms (2,000 pounds) in its cargo area at the time of the crash.

The Chevrolet pickup sustained direct contact damage to the left half of the front plane, with the left half of the front bumper displaced rearward (**Figures 6** and **7** above). In addition, the front grille was shattered, the radiator frame was bent, the female hood latch mechanism was pulled to the left, both headlamp assemblies were shattered, the left half of the hood was displaced rearward, and the left fender was shoved rearward. Induced damage included the left front wheel pushed into the lower "A"-pillar (**Figure 7** above); the front of the left rocker panel shoved upward; the upper left "A"-pillar shoved rearward; the left half of the windshield cracked; the left roof rail deformed; the left front door panel bowed outward; the left front door, the right front door, and the backlite glazings shattered (kernelized); the left "B"-pillar bent rearward; and the left rear roof rail buckled.

Based on available police photographs, a CDC for the Chevrolet pickup was estimated as: **12-FYEW-3 (10)** [maximum crush was approximated at 80 centimeters (31.5 inches)]. The WinSMASH reconstruction program, barrier algorithm, was used on the Chevrolet pickup's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 32.9 km.p.h. (20.4 m.p.h.), -32.4 km.p.h. (-20.1 m.p.h.), and -5.7 km.p.h. (-3.5 m.p.h.). This reconstruction is considered a borderline reconstruction, but this estimate appears to be reasonable. The Chevrolet pickup was towed due to disabling damage.

The Chevrolet pickup's driver [29-year-old, Black (unknown if Hispanic) male; of unknown height and weight] was reportedly restrained and sustained, according to the Police Crash Reported, "B" (non-incapacitating) injuries. There were no other occupants in the Chevrolet pickup.



Police Crash Report Schematic