

School Bus Investigation/Vehicle to Vehicle
Dynamic Science, Inc./Case Number: DS05010
2003 Bluebird Micro-Bird - GMC Savana Cutaway Van
Utah
June 2006

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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.

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<p>16. Abstract</p> <p>The focus of this on-site investigation was the performance of a 2003 Bluebird Micro-Bird school bus that was involved in a head-on crash with a semi tractor-trailer. The crash occurred at 1511 hours on a two-lane, two way highway in a rural area of Utah. The school bus was being driven by a 22-year-old male. The bus had sixteen additional occupants, two adult counselors and fourteen children. The children were being transported back to a summer camp after a day of swimming. The driver of the bus was restrained with a 3-point manual lap and shoulder belt. This Bluebird Micro-Bird bus did not originally have seat belts in any of the passenger seats, but the owners of the bus had after-market manual lap belts installed in all sixteen passenger seat locations. According to police investigators, some of the children and/or adults were wearing the lap belts, but the police report did not indicate which of the occupants were restrained. Upon inspection, it did not appear that any of the passengers were restrained at the time of the crash.</p> <p>The other vehicle was a 2004 Freightliner Conventional ST120 cab-behind-engine (CBE) tractor pulling an empty 1994 Wabash trailer. The Bluebird school bus was traveling westbound and the Freightliner was traveling eastbound. The driver of the school bus apparently fell asleep at the wheel and the school bus drifted to the left into the path of the Freightliner. The driver of the semi attempted to avoid the collision by braking and steering right. The tractor-trailer had almost come to a complete stop when the school bus struck the semi head-on. According to the police report, the driver of the bus and the fourteen children all sustained "broken bones or bleeding wounds" and the two adult passengers sustained "possible" injuries. One adult and thirteen children were transported to local hospitals by ambulance. All were released later the same day.</p>			
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Crash Investigation
Case Number: DS05010

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Background

The focus of this on-site investigation was the performance of a 2003 Bluebird Micro-Bird school bus that was involved in a head-on crash with a semi tractor-trailer. The crash occurred at 1511 hours on a two-lane, two way highway in a rural area of Utah. The school bus was being driven by a 22-year-old male. The bus had sixteen additional occupants, two adult counselors and fourteen children. The children were being transported back to a summer camp after a day of swimming. The driver of the bus was restrained with a 3-point manual lap and shoulder belt. This Bluebird Micro-Bird bus did not originally have seat belts in any of the passenger seats, but the owners of the bus had manual lap belts installed in all sixteen passenger seat locations. According to police investigators, some of the children and/or adults were wearing the lap belts, but the police report did not indicate which of the occupants were restrained. Upon inspection, it did not appear that any of the passengers were restrained at the time of the crash.



Figure 1. 2003 Bluebird Micro-Bird school bus

The other vehicle was a 2004 Freightliner Conventional ST120 cab-behind-engine (CBE) tractor pulling an empty 1994 Wabash trailer. The Bluebird school bus was traveling westbound and the Freightliner was traveling eastbound. The driver of the school bus apparently fell asleep at the wheel and the school bus drifted to the left into the path of the Freightliner. The driver of the semi attempted to avoid the collision by braking and steering right. The tractor-trailer had almost come to a complete stop when the school bus struck the semi head-on. According to the police report, the driver of the bus and the fourteen children all sustained “broken bones or bleeding wounds” and the two adult passengers sustained “possible” injuries . One adult and thirteen children were transported to local hospitals by ambulance. All were released later the same day.

This School Bus case was identified through the Office of Vehicle Safety Compliance. DSI was assigned the case on June 24, 2005. Field work was completed on July 6, 2005.

SUMMARY

Crash Site

This two vehicle crash occurred in June at 1511 hours in a rural area of Utah. This two vehicle crash occurred on a two-lane, two-way, undivided municipal highway. The roadway has an east/west configuration. The two asphalt travel lanes are divided by painted yellow “no passing” double lane lines. There is a parking lane located on the north side of the street. Adjacent to the parking lane was a curb and sidewalk. On the south side of the travel lanes, there is a paved shoulder that leads to a grassy field. There is a 3% uphill grade in the westbound direction of travel.



Figure 2. Approach to area of impact (west)

Pre-Crash

The school bus was being operated by a 22-year-old restrained male. The bus was transporting two adult counselors and fourteen children. The children were being transported back to a summer camp after a day of swimming. According to a representative of the school bus company, the on-board lap belts were added at some point after the vehicle had been purchased. It does not appear that any the passengers were using the lap belts at the time of the crash.



Figure 3. Approach to area of impact (east)

The other vehicle was a 2004 Freightliner Conventional ST120 CBE tractor pulling an empty 1994 Wabash trailer. The vehicle had a gross vehicle weight rating of 36,287 kg (80,000 lbs) and was licensed for interstate commercial operations. The tractor was configured with three axles, the trailer with two. The Freightliner was being operated by a 44-year-old female.

The Bluebird school bus was traveling westbound at a police estimated speed of 56 km/h (35 mph). The Freightliner was traveling eastbound.

The driver of the school bus apparently fell asleep at the wheel and the school bus drifted to the left into the eastbound lane of travel. The driver of the Freightliner saw the school bus coming into her lane. She began braking and steering right in an attempt to avoid the collision. Prior to impact, the Freightliner was nearly stopped.

Crash

The right front of the Bluebird school bus (12FDAW6) struck the front left of the Freightliner, resulting in the deployment of the case vehicle's driver front air bag. The front of the Bluebird school bus crushed back to the right windshield area, resulting in moderate longitudinal intrusion which caused the case vehicle's right entrance doors to partially open. The bus came to final rest in the eastbound travel lane, facing west while still in contact with the semi. The tractor-trailer did not move from the point of impact and remained in the eastbound lane, facing east.



Figure 4. Final rest position for both vehicles

Post-Crash

Both vehicles were towed from the scene due to damage. According to the police report, both vehicles sustained \$10,000 in damage. All of the occupants were able to exit the vehicle under their own power. The two on-board counselors helped and directed the children to the rear of the bus where they got out through the rear emergency exit. Emergency medical personnel responded to the crash and arrived on scene approximately 10 minutes after the collision. According to the police report, the driver of the bus and the fourteen children all sustained “broken bones or bleeding wounds” and the two adult passengers sustained “possible” injuries. See Figure 6 for more details on the ages, seat locations and injuries for each of the passengers. One adult and thirteen children were transported to local hospitals by ambulance. All were released later the same day.



Figure 5. Final rest 2004 Freightliner tractor-trailer (police markings)

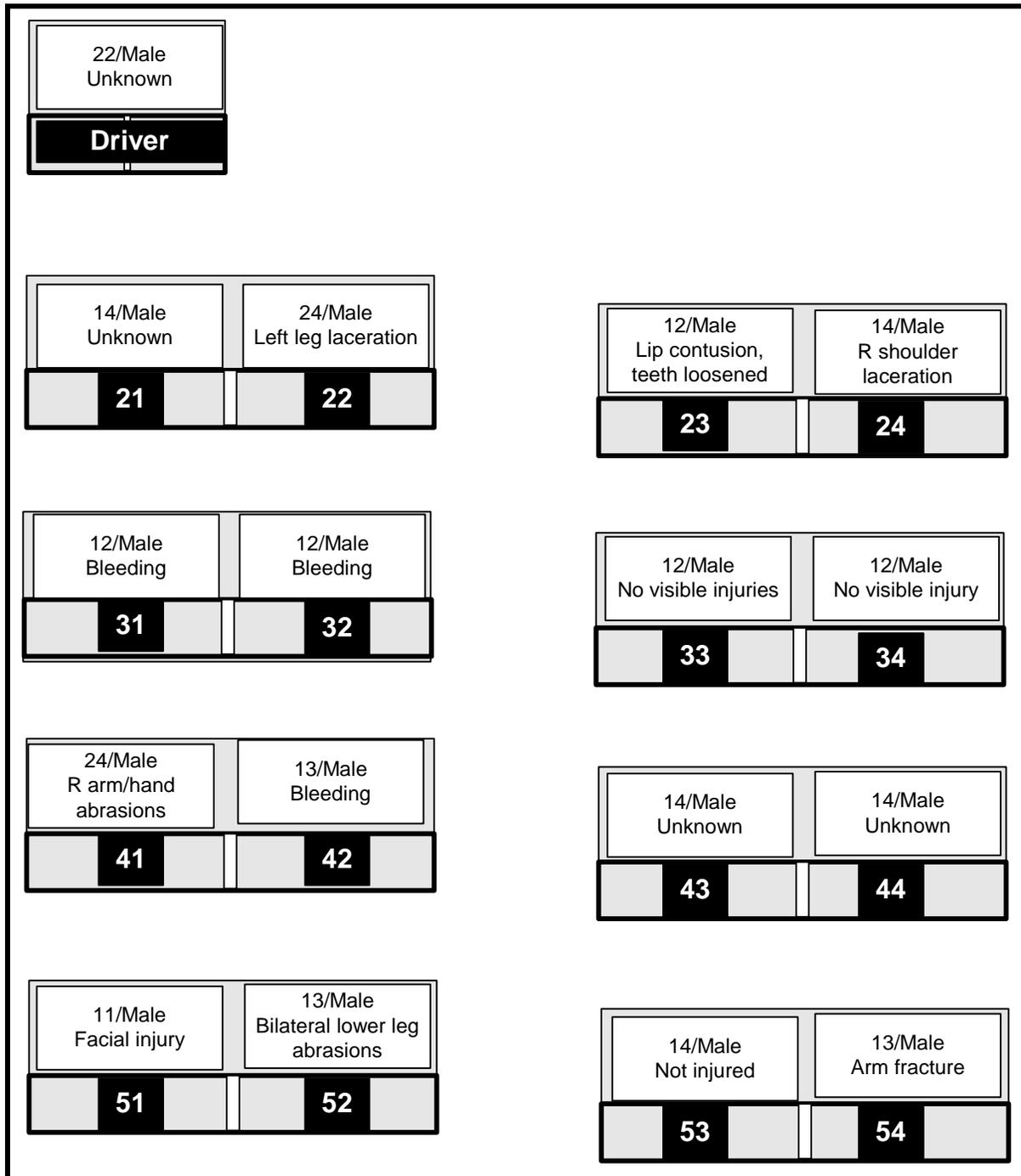


Figure 6. Occupant seating positions/injuries

Vehicle Data - 2003 Bluebird Micro-Bird

The case vehicle was a 2003 Bluebird Micro-Bird (Model TG33803) school bus. The bus body was mounted on an incomplete 2003 GMC 3500 cutaway van chassis (VIN: 1GDJG31U731xxxxxx). The Bluebird Micro-Bird school bus was equipped with a 6.0 liter V8 engine, 4-speed automatic transmission, hydraulic anti-lock brakes, daytime running lights, a tilt steering wheel and a heavy duty front bumper. The body is mounted to the chassis using a heavy-duty energy absorbing rubber isolator system, which helps to reduce vibration and extends the life of the vehicle. The vehicle had a gross vehicle weight rating of 5,443 kg (12,000 lbs). The school bus was painted National School Bus Glossy Yellow.

The 2003 Bluebird Micro-Bird was equipped with BF Goodrich Commercial All Season LT22575/R16 tires in the front and Uniroyal Laredo LT22575/R16 tires on the rear duals. The manufacturer recommended cold tire pressure was 448 kPa (65 psi). The specific tire data is as follows:

Tire	Tread	Measured Pressure	Tire Manufacturer Recommended Pressure	Restricted	Damage
LF	10 mm (13/32 in)	455 kPa (66 psi)	552 kPa (80 psi)	N	None
LR outer	6 mm (7/32 in)	434 kPa (63 psi)	448 kPa (65 psi)	N	None
LR inner	6 mm (7/32 in)	Unknown	Unknown	N	None
RR outer	6 mm (8/32 in)	469 kPa (68 psi)	448 kPa (65 psi)	N	None
RR inner	6 mm (7/32 in)	Unknown	Unknown	N	None
RF	10 mm (13/32 in)	Flat	552 kPa (80 psi)	N	Holed

The 2003 Bluebird Micro-Bird was designed to carry one driver and 16 passengers. The driver's seat position was configured as a fabric covered bucket seat with an integral head restraint. The passenger seating in the bus was configured as sixteen individual fabric covered bucket seats. On the right and left sides of the bus, there were four rows consisting of two seats, with a walkway running down the middle of the rows. All sixteen seating positions were equipped with integral head restraints.

Vehicle Damage

Exterior Damage - 2003 Bluebird Micro-Bird

Damage Description: The bus sustained severe front end damage as a result of the impact with the semi tractor-trailer. The 2003 Bluebird Micro-Bird sustained 90.0 cm (35.4 in) of direct damage beginning at the right front bumper corner, extending along the front bumper to the left. The semi tractor overrode the front bumper of the school bus. The location of maximum crush was at the right front bumper corner and measured 50.0 cm (19.7 in) at the bumper and 146.0 cm (57.5 in) at the radiator upper support, averaged to 98.0 cm (38.6 in). Six crush measurements were documented along the front bumper and above the front bumper at the radiator upper support. There was a difference of greater than 13.0 cm (5.1 in) of crush at all of the C locations except C1. The averaged front crush was as follows: C1=37.0 cm (14.6 in), C2=39.5 cm (15.6 in), C3=54.0 cm (21.3 in), C4=79.5 cm (31.3 in), C5=83.5 cm (32.9 in), C6=98.0 cm (38.6 in).



Figure 7. Front right damage

CDC:	12FZAW6	
Delta V:	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown

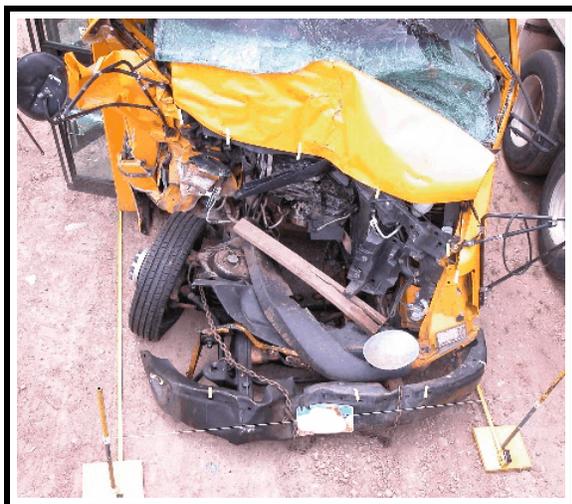


Figure 8. Front end damage

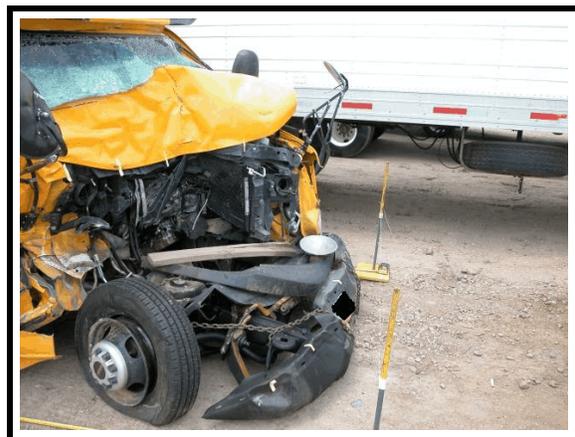


Figure 9. Crush profile

Interior Damage - 2003 Bluebird Micro-Bird

The bus sustained moderate interior damage due to occupant contacts, intrusion and normal air bag deployment related damage.

The driver's front air bag deployed as a result of the impact between the two vehicles. There was no damage or contact evidence located on either side of the air bag. Due to instrument panel intrusion, the steering wheel had shifted 15.0 cm (5.9 in) to the left.

There was integrity loss to the windshield and to the right side entrance door due to damage and resulting intrusion that occurred during the front end impact. The right entrance doors were stuck partially open and the bottom glazing in the lower right entrance door was cracked and deformed. The passenger compartment rearview mirror was cracked but remained in place. There were scuffs and indentations to nearly all of the seat backs in rows 2- 4. See Figure 13 for more information on the type and location of seat back occupant contacts that were found during the inspection. There were several bloodstains found in the passenger compartment interior.



Figure 12. Windshield integrity loss - right side



Figure 10. Damage to steering wheel/column and windshield integrity loss



Figure 11. Damaged front entrance door

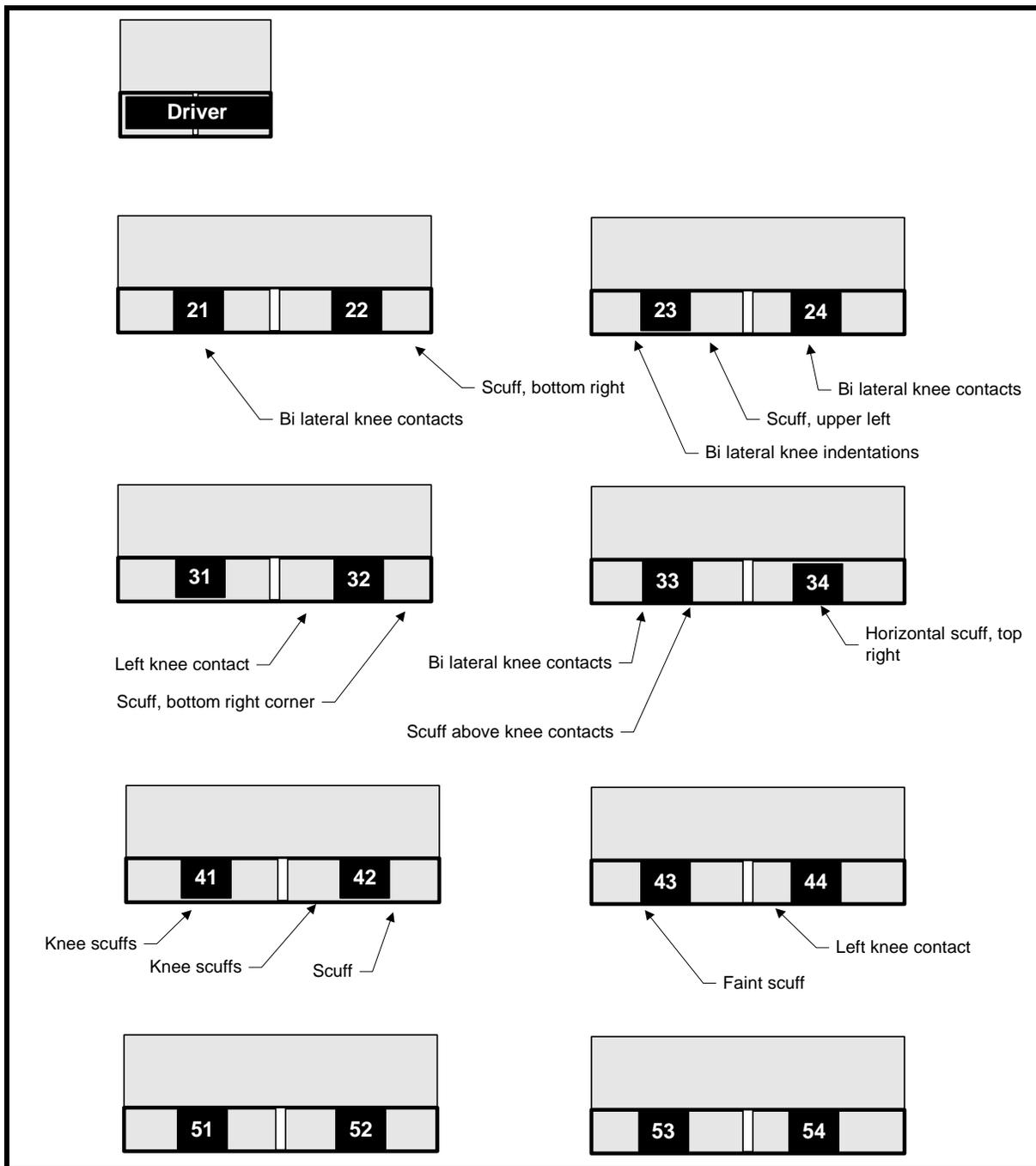


Figure 13. Occupant contact points

There was intrusion of multiple components into the passenger compartment. The steering wheel, instrument panel, toe pan and engine cowl intruded longitudinally into the driver's seating area. The instrument panel and engine cowl also intruded longitudinally into the right front area. Many of the seat backs intruded into the seating areas of other passengers, due to occupant contact. Please see Figure 15 for more information on the post-crash seat back angles of each of the bucket seats. The specific passenger intrusions were documented as follows:



Figure 14. Instrument panel damage/intrusion

Position	Intruded Component	Magnitude of Intrusion	Direction
1L	Steering wheel	59.0 cm (23.2 in)	Longitudinal
1L	Instrument panel (left)	53.0 cm (20.9 in)	Longitudinal
1L	Engine cowl	39.0 cm (15.4 in)	Longitudinal
1L	Toe pan	> 10.0 cm (3.9 in)	Longitudinal
1R	Engine cowl	39.0 cm (15.4 in)	Longitudinal
1R	Instrument panel (right)	36.0 cm (14.2 in)	Longitudinal
Seat 22	Seat back	13.0 cm (5.1 in)	Longitudinal
Seat 23	Seat back	54.0 cm (21.3 in)	Longitudinal
Seat 24	Seat back	20.0 cm (7.9 in)	Longitudinal
Seat 32	Seat back	65.0 cm (25.6 in)	Longitudinal
Seat 33	Seat back	56.0 cm (22.0 in)	Longitudinal
Seat 41	Seat back	6.0 cm (2.4 in)	Longitudinal
Seat 44	Seat back	19.0 cm (7.5 in)	Longitudinal

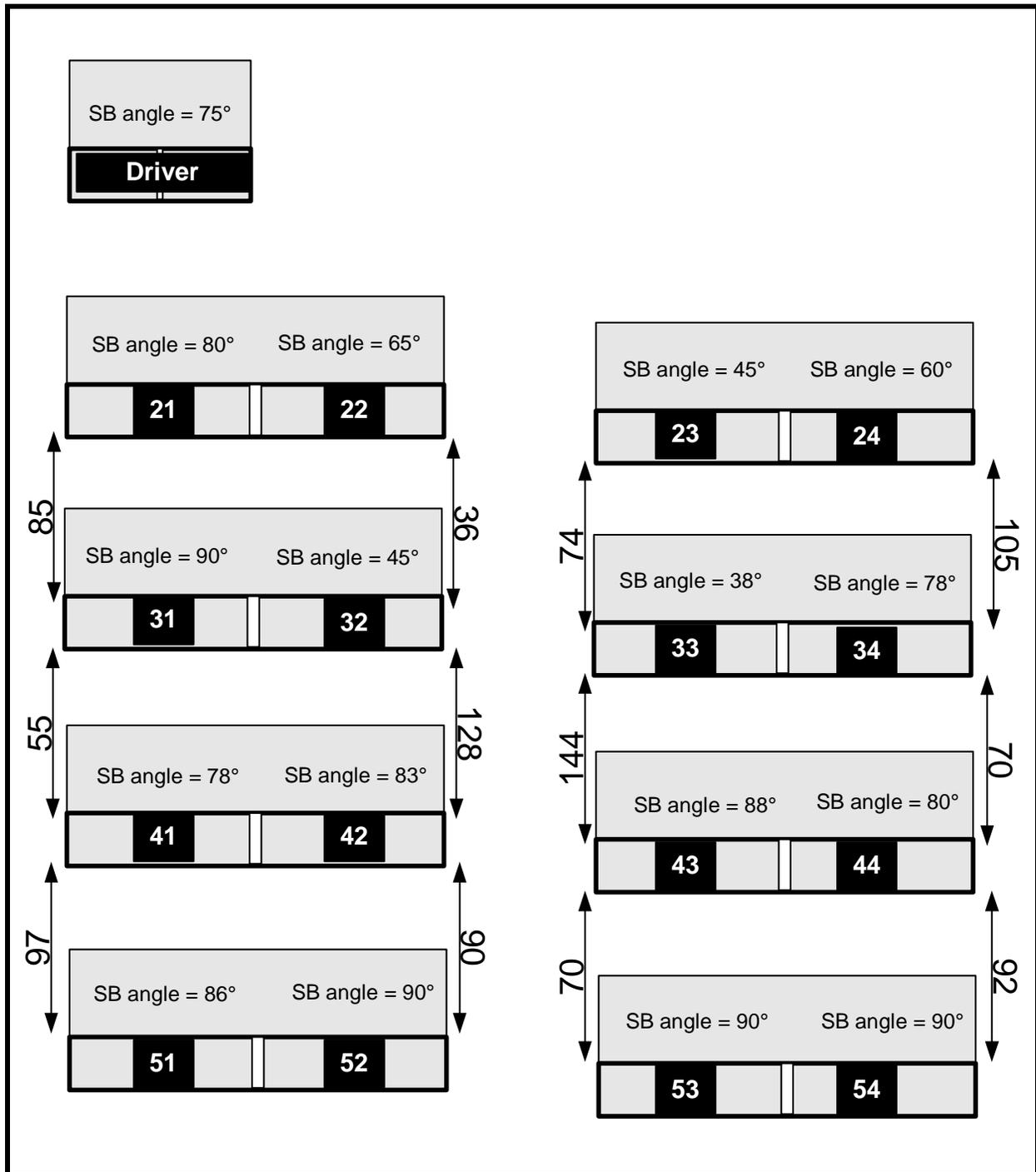


Figure 15. Post-crash seat back angles and distances between seat backs



Figure 16. Instrument panel intrusion and damage to the right front door mechanics



Figure 17. Passenger seat damage - left side



Figure 18. Passenger seat damage - right side

Manual Restraint Systems - 2003 Bluebird Micro-Bird

The 2003 Bluebird Micro-Bird was configured with a manual 3-point lap and shoulder belt for the driver's seat position. The driver's seat belt height adjuster was in the full up position. The passenger seats did not originally come equipped with safety belts, but the owners of the bus had manual lap belts installed in all 16 seats. The driver's safety belt was configured with a sliding latchplate and an emergency locking retractor (ELR). The sixteen lap belts were configured with sliding latchplates. It appears that only the driver of the bus was restrained at the time of the collision.



Figure 19. After-market lap belts - installed in all passenger positions



Figure 20. After-market seat belt buckles



Figure 21. After market seat belt buckle type



Figure 22. Closer view - After market seat belt buckle attachment point

Supplemental Restraints System - 2003 Bluebird School Bus

The 2003 Bluebird/GMC 3500 was equipped with a driver frontal air bag. During the impact, the driver's air bag deployed from the center of the steering wheel through symmetrical H-configuration module cover flaps. Each flap measured 11.5 cm (4.5 in) in height and 7.0 cm (2.8 in) in width. The deployed air bag measured 44.0 cm (17.3 in) in diameter in its deflated state. The air bag was tethered by a single internal tether. Two circular vent ports were located at the 11 and 1 o'clock aspects on the rear of the air bag. The deployed air bag was not damaged and showed no signs of occupant contact.



Figure 23. Driver's air bag

Vehicle Data - 2004 Freightliner CBE Tractor pulling a 1994 Wabash Trailer

Description:	2004 Freightliner Conventional ST120 tractor pulling an empty 1994 Wabash trailer	
VIN (Tractor):	1FUJBBCG54Lxxxxxx	
(Trailer):	1JJV532YZRLxxxxxx	
Odometer:	Unknown	
Engine:	12.7 L, 6 cylinder	
Reported Defects:	None noted	
Cargo:	No cargo at time of crash	
Damage Description:	Front end tractor damage, trailer undamaged	
TDC:	Unknown	
Delta V:	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown

Occupant Demographics - 2003 Bluebird School Bus

	Driver	Occupant 2	Occupant 3
Age/Sex:	22/Male	14/Male	24/Male
Seated Position:	Front left	Second row, seat 1	Second row, seat 2
Seat Type:	Fabric covered bucket seat	Fabric covered bucket seat	Fabric covered bucket seat
Height:	Unknown	Unknown	180 cm (71 in)
Weight:	Unknown	Unknown	82 kg (180 lb)
Occupation:	Camp counselor	Not Applicable	Camp counselor
Pre-existing Medical Condition:	None noted	None noted	None noted
Alcohol/Drug Involvement:	Blood test given, results unknown	Not Applicable	Not Applicable
Driving Experience:	6 years	Not Applicable	Not Applicable
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available - used	Lap belt available - unknown if used	Lap belt available - unknown if used
Air bag:	Driver front air bag - deployed	None available	None available

	Occupant 4	Occupant 5	Occupant 6
Age/Sex:	12/Male	14/Male	12/Male
Seated Position:	Second row, seat 3	Second row, seat 4	Third row, seat 1
Seat Type:	Fabric covered bucket seat	Fabric covered bucket seat	Fabric covered bucket seat
Height:	147 cm (58 in)	180 cm (71 in)	Unknown
Weight:	50 kg (110 lb)	64 kg (140 lb)	Unknown
Occupation:	Not Applicable	Not Applicable	Not Applicable
Pre-existing Medical Condition:	None noted	None noted	None noted
Alcohol/Drug Involvement:	Not Applicable	Not Applicable	Not Applicable
Driving Experience:	Not Applicable	Not Applicable	Not Applicable
Body Posture:	Turned to his right, talking to another passenger	Talking to a passenger to his left	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown
Restraint Usage:	Lap belt available - not used	Lap belt available - not used	Lap belt available - not used
Air bag:	None available	None available	None available

	Occupant 7	Occupant 8	Occupant 9
Age/Sex:	12/Male	12/Male	12/Male
Seated Position:	Third row, seat 2	Third row, seat 3	Third row, seat 4
Seat Type:	Fabric covered bucket seat	Fabric covered bucket seat	Fabric covered bucket seat
Height:	Unknown	Unknown	Unknown
Weight:	Unknown	Unknown	Unknown
Occupation:	Not Applicable	Not Applicable	Not Applicable
Pre-existing Medical Condition:	None noted	None noted	None noted
Alcohol/Drug Involvement:	Not Applicable	Not Applicable	Not Applicable
Driving Experience:	Not Applicable	Not Applicable	Not Applicable
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown
Restraint Usage:	Lap belt available - not used	Lap belt available - unknown if used	Lap belt available - not used
Air bag:	None available	None available	None available

	Occupant 10	Occupant 11	Occupant 12
Age/Sex:	24/Male	13/Male	14/Male
Seated Position:	Fourth row, seat 1	Fourth row, seat 2	Fourth row, seat 3
Seat Type:	Fabric covered bucket seat	Fabric covered bucket seat	Fabric covered bucket seat
Height:	Unknown	Unknown	Unknown
Weight:	Unknown	Unknown	Unknown
Occupation:	Camp counselor	Not Applicable	Not Applicable
Pre-existing Medical Condition:	None noted	None noted	None noted
Alcohol/Drug Involvement:	Not Applicable	Not Applicable	Not Applicable
Driving Experience:	Not Applicable	Not Applicable	Not Applicable
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown
Restraint Usage:	Lap belt available - not used	Lap belt available - not used	Lap belt available - unknown if used
Air bag:	None available	None available	None available

	Occupant 13	Occupant 14	Occupant 15
Age/Sex:	14/Male	11/Male	13/Male
Seated Position:	Fourth row, seat 4	Fifth row, seat 1	Fifth row, seat 2
Seat Type:	Fabric covered bucket seat	Fabric covered bucket seat	Fabric covered bucket seat
Height:	Unknown	152 cm (60 in)	147 cm (58 in)
Weight:	Unknown	35 kg (77 lb)	34 kg (75 lb)
Occupation:	Not Applicable	Not Applicable	Not Applicable
Pre-existing Medical Condition:	None noted	None noted	Asperger's syndrome - a developmental disorder similar to autism
Alcohol/Drug Involvement:	Not Applicable	Not Applicable	Not Applicable
Driving Experience:	Not Applicable	Not Applicable	Not Applicable
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown
Restraint Usage:	Lap belt available - unknown if used	Lap belt available - not used	Lap belt available - not used
Air bag:	None available	None available	None available

	Occupant 16	Occupant 17
Age/Sex:	14/Male	13/Male
Seated Position:	Fifth row, seat 3	Fifth row, seat 4
Seat Type:	Fabric covered bucket seat	Fabric covered bucket seat
Height:	Unknown	152 cm (60 in)
Weight:	Unknown	34 kg (75 lb)
Occupation:	Not Applicable	Not Applicable
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	Not Applicable	Not Applicable
Driving Experience:	Not Applicable	Not Applicable
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap belt available - not used	Lap belt available - not used
Air bag:	None available	None available

Occupant Demographics - 2004 Freightliner CBE tractor pulling a 1994 Wabash trailer

	Driver
Age/Sex:	44/Female
Seated Position:	Front left
Seat Type:	Unknown
Height:	Unknown
Weight:	Unknown
Occupation:	Truck driver
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	26 years
Body Posture:	Presumed to be upright, forward facing
Hand Position:	Unknown
Foot Position:	Presumed to be on the floorboards and/or foot controls
Restraint Usage:	Lap and shoulder belt used per the police report

Occupant Injuries - 2003 Bluebird School Bus

Driver: Unknown if injured. Per the police report, this occupant sustained “broken bones or bleeding wounds” to his legs.

Occupant #2/Seat 21: Unknown if injured. Per the police report, this occupant sustained “broken bones or bleeding wounds” to his face.

Occupant #3/Seat 22: Injuries obtained from the interview.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Laceration, left leg - NFS	890600.1,2	Divider	Possible

Occupant #4/Seat 23: Injuries obtained from the interview.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Contusion, upper lip	290402.1,8	Divider	Possible

Occupant #5/Seat 24: Injuries obtained from the interview.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Laceration NFS, right shoulder	790600.1,1	Interior side panel	Possible

Occupant #6/Seat 31: Unknown injuries. Per the police report, this occupant sustained “broken bones or bleeding wounds” to his face. Interview information confirmed this passenger was bleeding post-crash.

Occupant #7/Seat 32: Unknown injuries. Per the police report, this occupant sustained “broken bones or bleeding wounds” to his face. Interview information confirmed this passenger was bleeding post-crash.

Occupant #8/Seat 33: No visible injuries. Information obtained from the interview.

Occupant #9/Seat 34: No visible injuries. Information obtained from the interview.

Occupant #10/Seat 41: Injuries obtained from the interview.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Abrasion, right arm	790202.1,1	Interior side panel	Possible
Abrasion, right hand	790202.1,1	Interior side panel	Possible

Occupant #11/Seat 42: Unknown injuries. Per the police report, this occupant sustained “broken bones or bleeding wounds” to his face. Interview information confirmed this passenger was bleeding post-crash.

Occupant #12/Seat 43: Unknown if injured. Per the police report, this occupant sustained “broken bones or bleeding wounds” to his face.

Occupant #13/Seat 44: Unknown if injured. Per the police report, this occupant sustained “broken bones or bleeding wounds” to his face.

Occupant #14/Seat 51: Injuries obtained from the interview.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Visible facial injury - NFS	Unknown	Seat back	Possible

Occupant #15/Seat 52: Injuries obtained from the interview.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Abrasions, lower legs, bilateral	890202.1,3	Seat back	Possible
Contusion, right orbit	297402.1,1	Seat back and glasses (being worn at time of crash)	Possible

Occupant #16/Seat 53: No visible injuries. Information obtained from the interview.

Occupant #17/Seat 54: Injuries obtained from the interview.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Arm fracture - NFS	Unknown	Seat back	Possible

Occupant Injuries - 2004 Freightliner CBE tractor pulling a 1994 Wabash trailer

Driver: Not injured according to police.

Occupant Kinematics - 2003 Bluebird School Bus

Driver Kinematics

The 22-year-old male driver of the case vehicle was seated forward facing in the fabric covered bucket seat and was restrained by the available 3-point manual lap and shoulder belt. The shoulder belt anchorage adjustment was in the full up position. The seat was adjusted to the forward most track position. The seat back was reclined at a 75 degree angle and the seat bottom had a 14 degree angle.

Just prior to the crash, this driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound traffic. The driver of the 2004 Freightliner tractor that was traveling eastbound, saw the bus entering her travel lane and began braking and steering right in an attempt to avoid a collision. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The impact resulted in the deployment of the driver's front air bag. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield. The case vehicle's instrument panel intruded into the passenger compartment. This intrusion caused the steering wheel and column to shift 15.0 cm (6.0 in) to the left, and damaged the right front door's opening mechanism, causing the double-doors to partially open.

The force of the impact caused the driver to load his seat belt as he initiated a forward trajectory towards the 12 o'clock direction of force. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

According to police, this occupant sustained "broken bones or bleeding wounds" to his legs. It is believed that he was transported to an area hospital where he was treated and released.

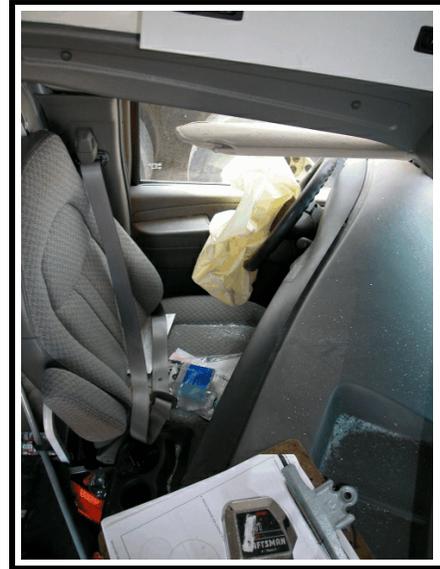


Figure 24. Driver's seating area

Occupant #2 Kinematics

This 14-year-old male passenger was seated in the second row, first seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. It is not known whether or not this passenger was restrained with the seat belt.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.

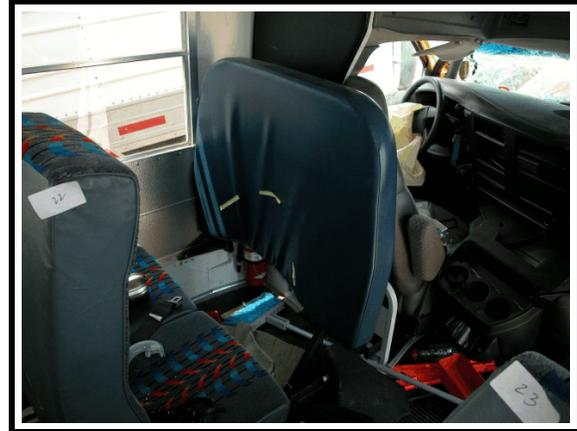


Figure 25. Padded divider separating driver and second row/left passengers

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the padded divider located between the back of the driver's seat back and this occupant's seating area. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 80 degrees. It appears that the back of the seat back was struck by passengers in the row behind him, deforming it.

He was assisted by the adult passengers and exited the vehicle through the rear emergency door. According to police, this occupant sustained facial "broken bones or bleeding wounds". It is believed that he was transported to an area hospital where he was treated and released.

Occupant #3 Kinematics

This 24-year-old male passenger was seated in the second row, second seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. It is not known whether or not this passenger was restrained with the seat belt.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the divider located between the back of the driver's seat back and this occupant's seating area. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 65 degrees. It appears that the back of the seat back was struck by passengers in the row behind him, deforming it.

This occupant sustained a laceration to his left leg. He was transported to an area hospital where he was treated and released.

Occupant #4 Kinematics

This 12-year-old male passenger was seated in the second row, third seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. This passenger was not restrained at the time of the crash. He was sitting upright and was turned to his right, talking to the passenger next to him.

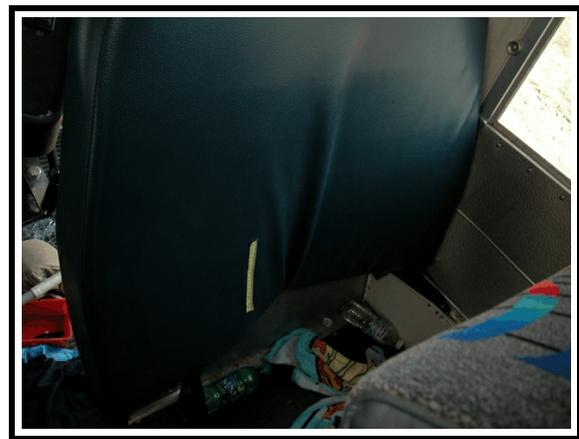


Figure 26. Padded divider separating second row/right seats from front entrance

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield. The case vehicle's instrument panel intruded into the passenger compartment, resulting in damage to the right front door's opening mechanism, causing the double-doors to partially open.

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the padded divider located between this occupant's seating area and the right front door entrance. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 45 degrees. It appears that the back of the seat back was struck by passengers in the row behind him, deforming it. According to the interview sources, this occupant was still in his seat post-crash. He was assisted by the adult passengers and exited the vehicle through the rear emergency door. This occupant sustained an upper lip contusion and was transported to an area hospital where he was treated and released.

Occupant #5 Kinematics

This 14-year-old male passenger was seated in the second row, fourth seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. This passenger was not restrained at the time of the crash. He was sitting upright and was talking to the passenger seated to his left.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield. The case vehicle's instrument panel intruded into the passenger compartment, resulting in damage to the right front door's opening mechanism, causing the double-doors to partially open.

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the padded divider located between this occupant's seating area and the right front door entrance. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 60 degrees. It appears that the back of the seat back was struck by passengers in the row behind him, deforming it. He was assisted by the adult passengers and exited the vehicle through the rear emergency door. This occupant sustained a right shoulder laceration and a nosebleed and was transported to an area hospital where he was treated and released.

Occupant #6 Kinematics

This 12-year-old male passenger was seated in the third row, first seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. This passenger was not restrained at the time of the crash.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.



Figure 27. Back of Seat 21

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the seat back in front of him. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 90 degrees. He was assisted by the adult passengers and exited the vehicle through the rear emergency door. According to police, this occupant sustained facial "broken bones or bleeding wounds". Interview information confirmed this passenger was bleeding post-crash, but specific injury information could not be obtained. It is believed that he was transported to an area hospital where he was treated and released.

Occupant #7 Kinematics

This 12-year-old male passenger was seated in the third row, second seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. This passenger was not restrained at the time of the crash.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the seat back in front of him.

The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 45 degrees. He was assisted by the adult passengers and exited the vehicle through the rear emergency door. According to police, this occupant sustained facial "broken bones or bleeding wounds". Interview information confirmed this passenger was bleeding post-crash, but specific injury information could not be obtained. It is believed that he was transported to an area hospital where he was treated and released.



Figure 28. Back of Seat 22

Occupant #8 Kinematics

This 12-year-old male passenger was seated in the third row, third seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. It is unknown if this passenger was restrained at the time of the crash.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the seat back in front of him. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 38 degrees. He was assisted by the adult passengers and exited the vehicle through the rear emergency door. According to police, this occupant sustained facial "broken bones or bleeding wounds". Interviewees reported that this occupant had no visible injuries. It is not known if he was medically treated.

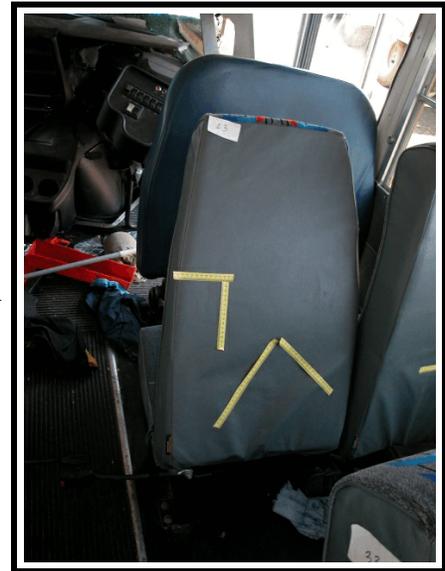


Figure 29. Back of Seat 23

Occupant #9 Kinematics

This 12-year-old male passenger was seated in the third row, fourth seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. This passenger was not restrained at the time of the crash.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the seat back in front of him. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 78 degrees. He was assisted by the adult passengers and exited the vehicle through the rear emergency door. According to police, this occupant sustained facial "broken bones or bleeding wounds". Interviewees reported that this occupant had no visible injuries. It is not known if he was medically treated.

Occupant #10 Kinematics

This 24-year-old male passenger was seated in the fourth row, first seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. This passenger was not restrained at the time of the crash.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.



Figure 30. Back of Seat 24

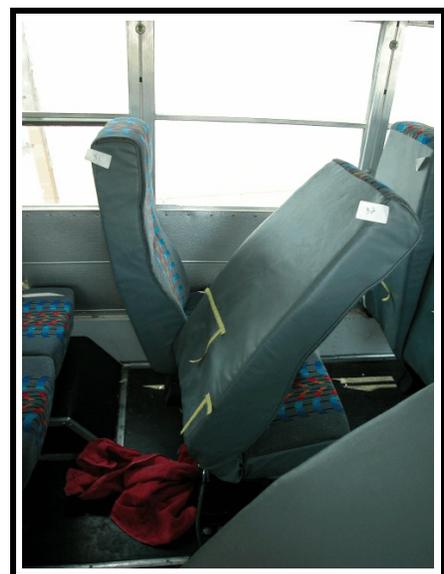


Figure 31. Seats 31 & 32

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact one of the seat backs in front of him. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 78 degrees. It appears that the back of the seat back was struck by passengers in the row behind him, deforming it. This occupant helped assist passengers exit the vehicle through the rear emergency door. He sustained abrasions to his right arm and hand. He was transported to an area hospital where he was treated and released.

Occupant #11 Kinematics

This 13-year-old male passenger was seated in the fourth row, second seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. This passenger was not restrained at the time of the crash.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.



The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the seat back in front of him. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 83 degrees. He was assisted by the adult passengers and exited the vehicle through the rear emergency door. According to police, this occupant sustained facial "broken bones or bleeding wounds". Interview information confirmed this passenger was bleeding post-crash, but specific injury information could not be obtained. It is believed that he was transported to an area hospital where he was treated and released.

Occupant #12 Kinematics

This 14-year-old male passenger was seated in the fourth row, third seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. It is not known whether or not this passenger was restrained with the seat belt.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the seat back in front of him. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 88 degrees. It appears that the back of the seat back was struck by passengers in the row behind him, slightly deforming it.

He was assisted by the adult passengers and exited the vehicle through the rear emergency door. According to police, this occupant sustained facial "broken bones or bleeding wounds". It is believed that he was transported to an area hospital where he was treated and released.



Figure 33. Back of Seat 33

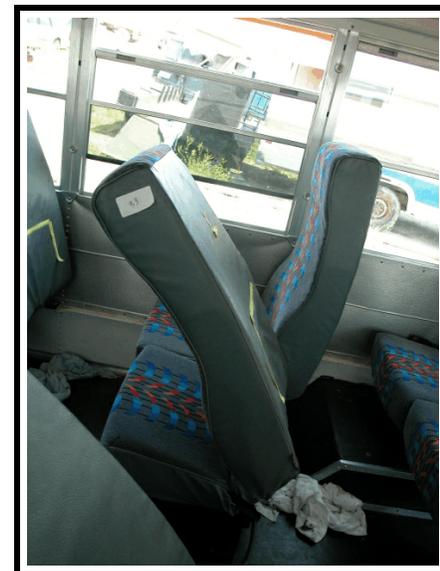


Figure 34. Seats 33 & 34

Occupant #13 Kinematics

This 14-year-old male passenger was seated in the fourth row, fourth seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. It is not known whether or not this passenger was restrained with the seat belt.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.



Figure 35. Back of Seat 34

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the seat back in front of him. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 80 degrees. It appears that the back of the seat back was struck by passengers in the row behind him, slightly deforming it.

He was assisted by the adult passengers and exited the vehicle through the rear emergency door. According to police, this occupant sustained facial "broken bones or bleeding wounds". It is believed that he was transported to an area hospital where he was treated and released.

Occupant #14 Kinematics

This 11-year-old male passenger was seated in the fifth row, first seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. This passenger was not restrained.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner.

The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the seat back in front of him. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 86 degrees. According to the interview sources, this occupant was still in his seat post-crash. He was assisted by the adult passengers and exited the vehicle through the rear emergency door. He sustained a visible facial injury (specifics unknown) and was transported to an area hospital where he was treated and released.

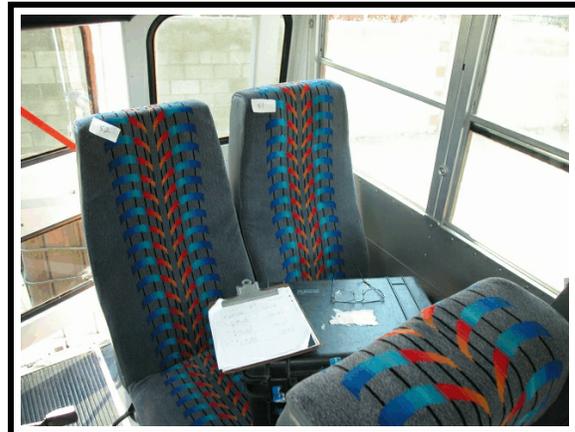


Figure 36. Seats 51 & 52



Figure 37. Back of Seat 41

Occupant #15 Kinematics

This 13-year-old male passenger was seated in the fifth row, second seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. This passenger was not restrained. He may have been reading just before the collision.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the seat back in front of him. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 90 degrees. According to the interview sources, this occupant flew forward and traveled up and over the seat back directly in front of him. He may have lost consciousness momentarily. When the crash was over, he was kneeling in the center aisle and his arms were draped over one or more of the seat cushions. He was assisted by the adult passengers and exited the vehicle through the rear emergency door. He sustained a right eyebrow contusion and lower leg abrasions and was transported to an area hospital where he was treated and released. He had been wearing glasses, which may have caused the eyebrow contusion.



Figure 38. Back of Seat 42



Figure 39. Blood (likely from this occupant) on seat back, Seat 43

Occupant #16 Kinematics

This 14-year-old male passenger was seated in the fifth row, third seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. This passenger was not restrained.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner.

The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, likely causing him to contact the seat back in front of him. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 90 degrees. He was assisted by the adult passengers and exited the vehicle through the rear emergency door. According to police, this occupant sustained facial "broken bones or bleeding wounds". Interviewees reported that this occupant was not injured.



Figure 40. Seats 53 & 54



Figure 41. Seats 43 & 44

Occupant #17 Kinematics

This 13-year-old male passenger was seated in the fifth row, fourth seat. The fabric covered bucket seat was forward facing and had an after market manual lap belt available. This passenger was not restrained.

Just prior to the crash, the driver apparently fell asleep and the Bluebird bus began to drift to the left. The case vehicle crossed over the double yellow lane lines separating east and westbound vehicles. The tractor-trailer had nearly come to a complete stop when the front of the Bluebird school bus impacted the front of the Freightliner. The tractor overrode the front bumper on the bus and crushed the engine compartment back to the windshield.

The force of the impact caused this passenger to initiate a forward trajectory towards the 12 o'clock direction of force, causing him to contact the seat back in front of him. The case vehicle continued a short distance forward as the tractor crushed the Bluebird's engine compartment. The bus came to final rest facing west in the eastbound lane, still in contact with the front of the Freightliner.

The post-crash angle of this occupant's seat back was 90 degrees. He was assisted by the adult passengers and exited the vehicle through the rear emergency door. He sustained a fractured arm and was transported to an area hospital where he was treated and released.

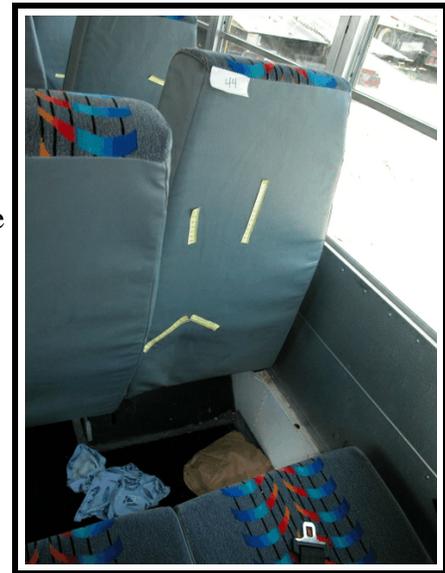


Figure 42. Back of Seat 44

Attachment 1. Scene Diagram

