Survival Factors Group Chairman's
Gray Summit, MO.
Factual Report

(Number of pages including this cover sheet – 21)

National Transportation Safety Board
Office of Highway Safety
Washington, DC 20594

Survival Factors Group Chairman's Factual Report

A. ACCIDENT

Type:	Truck Tractor, Pickup, School Bus Multivehicle Accident
Date and Time:	August 5, 2010, 10:11AM. CDT
Location:	Interstate 44 Eastbound West of Milepost 250.6 Gray Summit, Franklin County, Missouri
Vehicle #1:	2007 Volvo Truck Tractor
Motor Carrier:	Climate Express
Vehicle #2:	2007 GMC Sierra
Vehicle #3:	2003 Bluebird, 71-Passenger School Bus
Motor Carrier:	Copeland Bus Services, LLC
Vehicle #4:	2001 Bluebird, 72-Passenger Bus
Motor Carrier:	Copeland Bus Services, LLC
Fatalities:	02
Injuries:	38

NTSB #: **HWY-10-MH-018**

B. SURVIVAL FACTORS GROUP

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C. ACCIDENT SUMMARY

For a summary of the accident, refer to the *Accident Summary* report, which is available in the docket for this investigation.

D. DETAILS OF THE INVESTIGATION

The Survival Factors Group investigation focused on the following:

1. Documentation of the exterior and interior damage to the 2007 Volvo truck tractor Model VNL64T (VIN: 4V4NC9GHX7Nxxxxxx),
2. Documentation of the exterior and interior damage to the 2007 GMC Sierra 1500 Extended Cab 4x4 (VIN: 1GTEK19Z67Zxxxxxx),
3. Documentation of the exterior and interior damage to the 2003 Bluebird 71-passenger school bus (VIN: 1BABJCPH63Fxxxxxx),
4. Documentation of the exterior and interior damage to the 2001 Bluebird 72-passenger school bus (VIN: 1BABJCPH63Fxxxxxx),
5. Emergency response,
6. Interviews with first responders, school bus passengers, and witnesses.

1. 2007 VOLVO TRUCK TRACTOR EXTERIOR AND INTERIOR INSPECTION

The truck tractor sustained moderate damage to the back end around the fifth-wheel area from the impact with the GMC pickup truck and to the top half of the sleeper-berth from the override impact from the 2003 Bluebird 71-passenger school bus.

The rear impact and subsequent override from the GMC pickup resulted in both the rear tandem mud flaps being broken off and the left frame member being bent inward approximately 1 inch. In addition, the metal cross member between the frame rails, that supported the license plate and rear brake light, was crushed inward approximately 9 inches. The Safety Board measured the post crash wheelbase on the right and left sides of the truck tractor; the right side was 244 inches and the left side was 242.5 inches.

The impact from the 2003 Bluebird school bus to the sleeper berth resulted in the fiberglass shell being broken open. The horizontal damage started at the left side and extended to the right. The induced damage was measured at 76 inches and

the direct damage was measured at 53 inches. The vertical damage started 93 inches from the ground and extended upwards an additional 70 inches

The interior of the truck tractor was equipped with two seating positions with the driver seat being an Air-ride seat. The tractor was equipped with driver air bag which did not deploy. Both seats had three-point lap and shoulder restraints attached to the B-pillar of the cab. The driver's seat belt showed evidence of prior usage. An inspection of the D-ring, webbing and buckle showed no evidence of friction rub or cupping/stretching.

The interior of the cab sustained significant damage to the top portion of the sleeper berth but no damage to the driver or front right passenger seating area.

2. 2007 GMC 1500 SIERRA with EXTENDED CAB PICKUP TRUCK EXTERIOR AND INTERIOR INSPECTION

The exterior damage was catastrophic. The inspection of the pickup truck was conducted while the vehicle was on its' roof because that' was its position at final rest under the school bus and atop the Volvo tractors' fifth wheel. The GMC's impact with the rear of the Volvo tractor resulted in severe front end damage to the GMC. The combination of the rear impact from the 2003 Bluebird school bus followed by the rear impact from the 2001 Bluebird school bus into the 2003 Bluebird school bus resulted in the pickup truck being folded in half. The frame of the vehicle was folded into an upside down "U" shape.

The interior of the vehicle was totally collapsed. According to the wrecker company that was on the scene of the accident, the pickup truck was collapsed and folded in half so tightly that they had to attach a tow truck on each end and pull it apart to be able to extricate the driver. The rear seats were collapsed into the front seats and the front seatbacks were folded down flat to the seat cushion.

The vehicle was equipped with driver and passenger-side air bags which are equipped with separate sensors so only the driver's air bag deployed[1] since there was no one seated in the passenger seat position. It was also equipped with lap and shoulder belts, but due to the extent of damage, none could be inspected. According to the vehicle's Electronic Data Recorder[2] and first responders, the driver was not restrained by the available lap and shoulder restraint. The driver's seat belt was able to be inspected and it showed no evidence of usage in the accident.

The steering wheel did not appear to be deformed although the steering columns shear capsule was totally collapsed (i.e., pushed inward) and separated approximately 6 inches.

[1] Refer to Recorder Group Chairman's Factual Report for information gathered from the pickup's Electronic Data Recorder readout.
[2] IBID

3. 2003 BLUEBIRD 71-PASSENGER SCHOOL BUS

3.1 Exterior Damage

The bus sustained moderate front end damage from impacting the back of the GMC Sierra pickup truck and undercarriage damage from completely overriding the GMC and also hitting the sleeper berth of the Volvo truck tractor. The bus sustained serious damage to the rear from the override impact from the 2001 Bluebird 72-passenger school bus.

The bus's initial frontal impact damage with the GMC began at the left front corner and extended to the right. The direct damage was measured at 80 inches. Maximum crush was measured at 9 ½ inches to the left front bumper although it extended to the undercarriage as it overrode the GMC (Refer to Vehicle Group Chairman's Factual Report for undercarriage damage information). The driver's side windshield was knocked out and the passenger's side was severely cracked but still in place. The right side wheelbase was measured at 210 inches with the left measured at 211 ½ inches (original wheelbase is 210 inches).

The bus's rear impact from the 2001 Bluebird school bus resulted in severe damage and intrusion to the rear bumper and specifically to the back right half of the bus. The direct damage began at the right bumper corner and extended leftward approximately 35 inches. Due to the front of the striking 2001 Bluebird overriding the rear bumper of this 2003 Bluebird bus, the crush to the rear bumper was relatively minor (approximately 6 inches)) compared to the override damage into the passenger compartment. The residual crush into the passenger compartment was 62 inches. The severe override impact resulted in the rear emergency door and rear wall being crushed inward, the roof being buckled and crushed inward and upward. In addition, the right outside sidewall was crushed inward and out to the right. The emergency door supports and several roof pillars were cut during the extrication process.

3.2 Interior Damage

The vehicle was equipped with a bucket seat with cushion springs for the driver. Behind the driver's seat were eleven rows of three-person bench seats and a twelfth row being a two-person seat. The right side had twelve rows of three-person seats. The steering wheel had no noticeable deformation. Inspection of the driver's lap and shoulder restraint system showed a small heat abrasion near the latch and buckle connection.

The damage to the interior passenger seating area was primarily to the right side and the area of the rear emergency exit door. The back right wall panel adjacent to the emergency door and roof sustained significant damage from the intruding front

end of the intruding 2001 Bluebird school bus. All rear windows and three right side windows (#11-13) and one left side window (#13) were broken out.

The rear emergency door, back right wall panel, and roof intruded into the occupant compartment. The roof was crushed down approximately 45 inches into rows 11 and 12 on the right side coming 6 inches below the seat backs. The roof and sidewalls were also buckled inward at several locations towards the rear of the bus.

Inspection of the vehicle's interior revealed several occupant contacts. There were obvious occupant contacts (blood smears) to the intruding back wall and roof. In addition, there was a blood smear adjacent to the rear emergency window on the left side and some hair strands stuck in a rivet line of the roof forward of the front roof hatch.

The bus was equipped with 13 windows including 2 emergency exit windows (#4 and #10) on the right side and 13 windows including 2 emergency exit windows (#4 and #10) on the left side. In addition, the appropriate emergency exit identifying decals and instructions were included on the windows. At the time of the inspection, the top half of window #11 on the left side was half open. As previously mentioned, windows #11-13 on the right side and window #13 on the left side were broken out due to the rear impact. All the windows except the windshield and emergency exit windows were tempered glass.

According to the Bluebird representative, the emergency side windows are a 9 inch push-out split sash window assembly with laminated glass. The push-out window assembly consists of two split sash window panes within a hinged window assembly frame. The window assembly includes a horizontal hinge (located at the top of the window). A positive latch mechanism is located on the bottom of the frame assembly, which when released, allows the window to swing outward while remaining hinged at the top to provide emergency egress. The emergency release latch plate at the bottom of the window is elevated about 1/2" from the base of the window. When opened a warning buzzer goes off in the driver seating area alerting the driver of the opened window. According to the Bluebird representative, they no longer offer horizontal (top or bottom) hinged emergency exit windows, just vertically (or side) hinged.

Located in the front of the bus, as required[3], were the First Aid kit, a James King Triangle/Flair kit Model 1005, and an Amerex 5 pound A:B:C[4] or Multi-purpose Dry Chemical fire extinguisher Model # A500. According to the inspection sticker it was last inspected on February 2008 and was set to expire one

[3] NATIONAL SCHOOL TRANSPORTATION SPECIFICATIONS and PROCEDURES pg 30-31 under EMERGENCY EQUIPMENT A, B, C, and D

[4] An A:B:C or Multi-Purpose extinguishers utilize a specially fluidized and siliconized mono ammonium phosphate dry chemical. It chemically insulates Class A fires by melting at approximately 350°F and coats surfaces to which it is applied. It smothers and breaks the chain reaction of Class B fires and will not conduct electricity back to the operator.

year after that date. Additional safety equipment in the bus included two functioning emergency roof hatches (Transpec #'s A654545 and A654537) above rows three and nine.

All the three-person bench seats were 39-inches-wide with the seatbacks 28 ½-inches-high. The two-person bench seat was 27-inches-wide and 28 ½-inches-high. All the floor and wall anchors remained secured on both sides except for the seats in rows ten, eleven, and twelve on the right side. The forward floor post in row twelve was cut during the extrication process of the entrapped passenger and the rearward floor post and wall anchors were torn out. The forward floor post in row eleven was severely bent at a 20 degree angle forward and the rear post was bent forward at a 10 degree angle. The seatback of row eleven was touching the backside of the seatback in row ten and both wall anchors were pulled out. Both the floor anchors in row ten were bent forward with the front one at a 20 degree angle and the rear post at a 45 degree angle. The rear wall anchor was pulled out while the front one remained attached.

3.3 Seating Chart For 2003 Bluebird School Bus

Seating positions based on occupant interviews with nineteen of the twenty-four occupants and a seating chart supplied by the St. James High School.

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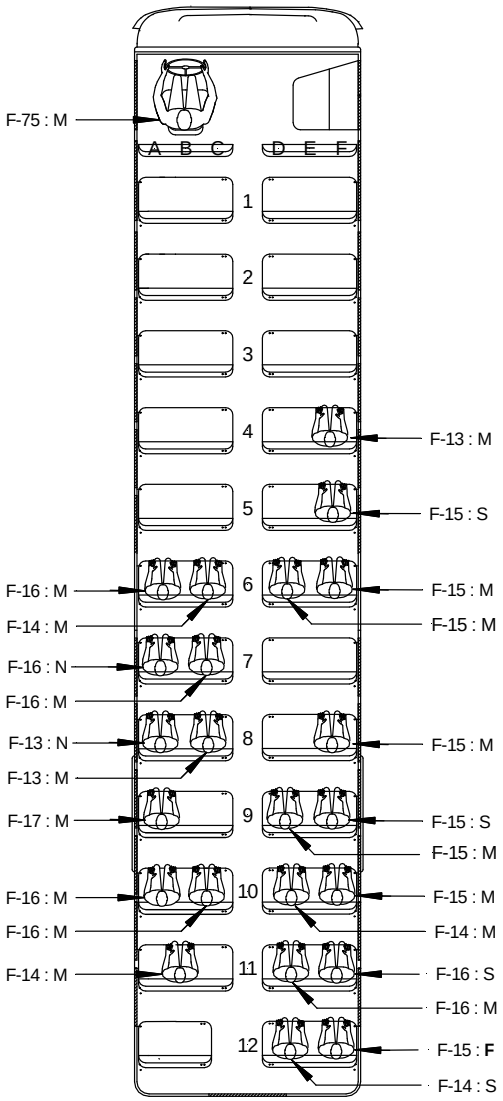
ICAO* INJURY LEGEND
N = None M = Minor S = Serious F = Fatal
F = FEMALE M = MALE # = AGE *International Civil Aviation Organization
SAMPLE INJURY LEVEL AGE GENDER F - 14 : Minor
Source: NTSB



4. 2001 BLUEBIRD 72-PASSENGER SCHOOL BUS

4.1 Exterior Damage

The bus sustained moderate front end damage from impacting the back of the 2003 Bluebird 71-passenger school bus.

The bus's frontal impact damage began at the left front corner and extended to the right 64 ½ inches. The direct damage was measured at 33 inches which also started at the left front bumper corner. The direct contact damage also extended vertically to the roof. Maximum crush was measured as 13 ½ inches to the left front bumper although the direct damage extended down the left side approximately 49 ½ inches breaking off the side rearview mirror and breaking open the drivers sliding window. Both windshield panes were knocked out leaving openings of 41 ¼ x 33 ½ inches.

The left side wheelbase measured 189 ½ inches with the right side wheelbase being 190 ¼ inches (original is 190 inches).

4.2 Interior Damage

The vehicle was equipped with a bucket seat with cushion springs for the driver. Behind the driver's seat were twelve rows of three-person bench seats on both sides. All the bench seats were 39-inches-wide with the seatbacks 24 ½-inches-high. All the floor and wall anchors remained secured on both sides.

Inspection of the vehicle's interior revealed that damage was primarily to driver's seating area. The instrument panel had 3 of the 5 gauges broken out. There was visible inward deformation to the steering wheel from loading by the driver. There were blood smears to the side wall adjacent to the driver seating area. An inspection of the driver's lap and shoulder restraint showed a small heat abrasion near the buckle/latch connection.

The bus was equipped with 13 windows including 2 emergency exit windows (#4 and #10) on the right side and 13 windows including 2 emergency exit windows (#4 and #10) on the left side. At the time of the inspection, the top half of the windows #1, 3, 8, 9, 11, and 13 on the left side were half open. Windows #1, 7, 10, and 12 on the right side were half open at the time of inspection. All the windows except the windshield and emergency exit windows were tempered glass.

Safety equipment in the bus consisted of two emergency roof hatches (Transpec #'s A521204 and A521214) above rows three and nine. Located in the front of the bus, as required[5], were the First aid kit, a James King Triangle/Flair kit Model

[5] NATIONAL SCHOOL TRANSPORTATION SPECIFICATIONS and PROCEDURES pg 30-31 under EMERGENCY EQUIPMENT A, B, C, and D

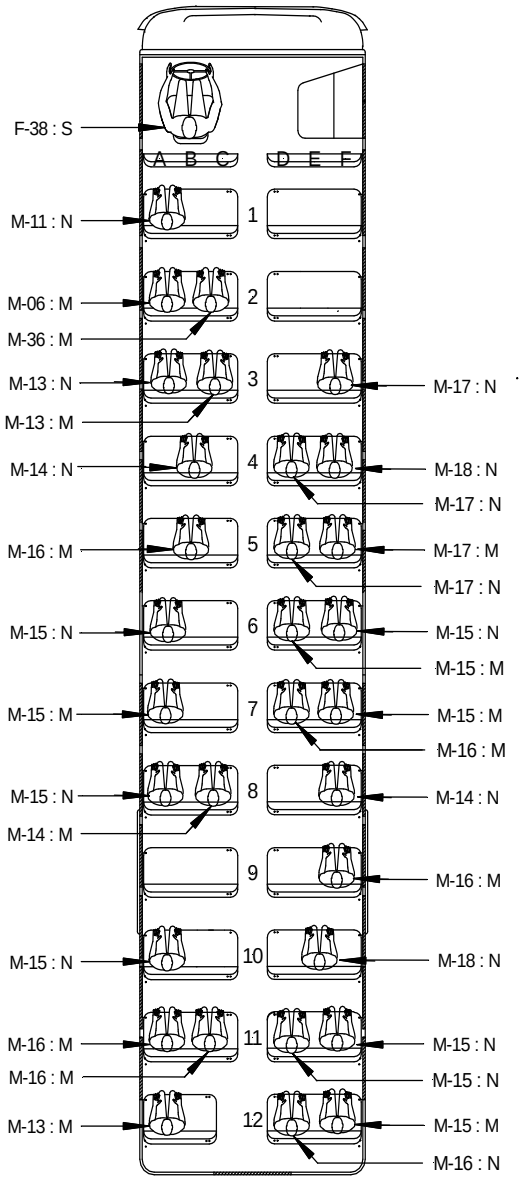
1005, and an Amerex 5 pound A:B:C or multi-purpose fire extinguisher. According to the inspection sticker it was last inspected on July 2009 and was set to expire one year after that date.

4.3 Seating Chart For 2001 Bluebird School Bus

Seating positions based on occupant interviews with nineteen of the thirty-two occupants and a seating chart supplied by the St. James High School.

GRAY SUMMIT, MISSOURI
HWY-10-MH-018

ICAO* INJURY LEGEND
N = None M = Minor S = Serious F = Fatal
F = FEMALE M = MALE # = AGE *International Civil Aviation Organization
SAMPLE INJURY LEVEL AGE GENDER F - 14 : Minor
Source: NTSB



5. EGRESS

The driver of the Volvo tractor exited under his own power while the driver of the GMC pickup truck had to be extricated. According to first responders the GMC driver was found on the floor of the cab with his head towards the right side door sill.

All the occupants in the 2003 Bluebird school bus were females while all the occupants of the 2001 Bluebird school bus were males. Based on interviews with emergency responders and passengers on both the buses, all but one occupant exited the 2003 Bluebird school bus through the left rear emergency exit window in row ten. The one injured passenger that was trapped and needed to be extricated was handed out by emergency responders on a backboard through the emergency exit window on the right side in row ten. All the occupants, except the adult Band leader, on the 2001 Bluebird school bus exited out the rear emergency exit door. The Band leader exited the bus through the front loading door.

During the interview process with the passengers of both buses, when asked about ever having emergency evacuation drills[6], the majority of students said that they had drills at least once while in grade school and although some were not familiar with how to operate the window exits, they were aware of where the exits were located.

Several female passengers interviewed stated that evacuation was made difficult due to the following;

- Getting their pants/shorts snagged on the emergency release latch plate at the bottom of the window while climbing out.
- Having to hold up the window while climbing out and then having it fall back on top of them as they climbed out. They eventually had a girl in the ninth row hold open the emergency exit window in the tenth row while they climbed out.

Federal Motor Vehicle Safety Standards 217[7] (FMVSS 217), Bus window retention and Release exist 1) to minimize the likelihood of occupants being thrown from the bus and 2) to provide a means of readily accessible emergency egress. Among the emergency exit window characteristics governed under FMVSS 217 are the minimum number of exit windows, their minimum size, designation as emergency exit windows, and the maximum force allowed to push out the window. To assist manufacturers in meeting the requirements, NHTSA published laboratory test procedures for school bus emergency exits and window retention and release.[8]

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[6] According to the School Superintendant, the school district requires all elementary schools students that ride the bus have emergency exit drills every year.

[7] See 49 Code of Federal Regulations 571.217.

[8] Laboratory Test Procedures for FMVSS 217: School Bus Emergency Exits And Window Retention And Release. TP-217-06, December 20, 1996 (National Highway Traffic Safety Administration).

The NTSB reviewed the test procedures for side emergency exit windows and found separate procedures for determining the maximum force requirements to push out the window, and the minimum exit size requirements to egress through the window. However, the procedures to do not address scenarios where occupants would need to push the window out and manually maintain it in the open position while attempting egress.

The National Congress on School Transportation publishes specifications and procedures that supplement FMVSS 217.[9] For rear emergency exit windows, which are large windows used in lieu of rear emergency exit doors for school buses with a rear engine; this document specifies that a lifting assistance device shall be in place that will aid in lifting and holding the window open. No such specification is provided to hold in place side emergency exit windows during evacuation.

The NTSB has previously addressed hindrances that could occur from emergency exits that fail to stay in the open position during evacuation. The NTSB issued the following recommendation to NHTSA after an accident between a pickup and a tour bus in Laredo, Texas, in 1984:

> H-86-61
> Revise Federal Motor Vehicle Safety Standard 217 to require a locking mechanism that would hold open side window emergency exits on intercity-type buses during use.

After receiving a response from NHTSA that rulemaking was not planned for this recommendation, it was classified "Closed, Unacceptable Action" in 1987. The NTSB also issued the following recommendation to NHTSA after a collision between a school bus and a delivery truck killed 21 students in Alton, Texas, in 1989:

> H-90-74
> Revise Federal Motor Vehicle Safety Standard 217, Bus Window Retention and Release, to include a requirement that floor level emergency exits should be designed so that once opened they remain open during emergencies and school bus evacuations.

In 1992, NHTSA published a final rule modifying FMVSS 217 so that floor level emergency exits remain open during school bus evacuations. As a result, the NTSB classified recommendation H-90-74 "Closed, Acceptable Action" in 1993.

6. SCHOOL BUS SAFETY

According to the School Bus Informational Council, each weekday during the school year, school transportation systems in the United States operate approximately 440,000 yellow school buses to provide safe and reliable

[9] *National School Transportation Specifications and Procedures.* Adopted by the Fifteenth National Congress on School Transportation, Warrensburg, Missouri May 16-20, 2010.

transportation for more than 24 million school-aged children[10]. This large transportation system is considered the largest mass transit program in the nation, with more than 55 million student trips per day[11], which equates to approximately 10 billion student trips per year[12].

Every year, on average, 20 school-aged children (i.e., younger than 19) are fatality injured as the result of school transportation-related[13] incidents. However, the school transportation system is considered one of the safest forms of transportation[14], with the National Safety Council reporting an overall school bus accident rate of 0.01 per 100 million vehicle-miles traveled, as compared with 0.04 for trains, 0.06 for commercial aviation, and 0.96 for other passenger vehicles[15].

Table 1 below shows that 6 school bus occupants died as a result of impacts to the rear of the school transportation vehicle during 1998-2008. [16]

Table 1. Total Occupant Fatalities in School Transportation-Related Crashes by Principal Impact Point on School Transportation Vehicle and Type of Crash, 1998-2008.

Principal Impact Point on School Transportation Vehicle	Type of Crash				Total	
	Single-Vehicle		Multiple-Vehicle			
	Crashes	Fatalities	Crashes	Fatalities	Crashes	Fatalities
Front	17	21	32	39	49	60
Right Side	7	9	9	11	16	20
Left Side	3	4	11	14	14	18
Rear	3	3	3	3	6	6
Top	0	0	1	4	1	4
Undercarriage	0	0	0	0	0	0
Non-Collision	8	8	0	0	8	8
Other/Unknown	1	1	1	1	2	2
Total	39	46	57	72	96	118

[10] School Bus Informational Council Washington, D.C., *National Statistics: Unequaled Safety Record*, 2008 [Online]. Available: http://sbi.elitedecision.com/index.php?option.com_content&task.view&id.13&Itemid.28

[11] "School Bus Safety Overview" *School Transportation News*, 2008 [Online]. Available: www.stnonline.com/stn/ datastatistics/safetyoverview/index.htm

[12] Pupil Transportation Facts, National Association for Pupil Transportation Foundation, Albany, N.Y., 2008 Online]. Available: www.naptfoundation.org/facts.html

[13] "School Transportation-Related Crashes", *Traffic Safety Facts*, National Center for Statistics and Analysis, National Highway Traffic Safety Administration, Washington, D.C., 2006

[14] Pupil Transportation Facts, National Association for Pupil Transportation Foundation, Albany, N.Y., 2008 Online]. Available: www.naptfoundation.org/facts.html

[15] "School Bus Safety Overview" *School Transportation News*, 2008 [Online]. Available: www.stnonline.com/stn/ datastatistics/safetyoverview/index.htm

[16] NHTSA fact sheet: http://www-nrd.nhtsa.dot.gov/Pubs/811165.pdf

Table 2 below is from an earlier NHTSA fact sheet from 1997 shows there were 14 deaths among school bus occupants as a result of rear impacts during 1987-1997.[17]

Table 2. Occupant Fatalities in School Bus-Related Crashes by Principal Impact Point on School Bus Vehicle, 1987-1997

Principal Impact Point on Bus	Type of Crash					
	Single-Vehicle		Multiple-Vehicle		**Total**	
	Crashes	Fatalities	Crashes	Fatalities	**Crashes**	**Fatalities**
Front	16	19	26	59	**42**	**78**
Right Side	6	6	10	15	**16**	**21**
Left Side	1	1	10	10	**11**	**11**
Rear	3	9	5	5	**8**	**14**
Top	2	3	0	0	**2**	**3**
Undercarriage	1	1	1	1	**2**	**2**
Noncollision	18	20	0	0	**18**	**20**
Unknown	1	1	0	0	**1**	**1**
Total	**48**	**60**	**52**	**90**	**100**	**150**

Currently five states [New York, New Jersey, Florida, California, and Texas (2010)] have required or are in the process of requiring seat belts on school buses. NHTSA continues to assert that compartmentalization, as defined by Federal Motor Vehicle Safety Standard No. 222, provides effective safety for large school bus occupants[18]. NHTSA is currently conducting crash tests of large school buses to determine the effectiveness of shoulder-lap belt combinations.

Missouri does not have a seat belt law for school buses. The provisions of the Missouri seat belt law[19] are:

- Every driver transporting a child under age 16 shall secure children accordingly (child seats for children under age 4 and less than 40 pounds, booster seats for children age 4 to 8 and less than 80 pounds or less than 4 feet 9 inches tall, and seat belts for older children).
- This law does not apply to children age 4 and older who are passengers on a school bus designed for carrying eleven passengers or more and is manufactured in accordance with Missouri Minimum Standards for School Buses.

[17]): http://www-nrd.nhtsa.dot.gov/Pubs/97SchoolBuses.pdf
[18] Transportation Research Board 1989; Booz, Allen & Hamilton and E. A. Williams & Associations, Inc. 1987
[19] Missouri Statutes Chapter 307 Vehicle Equipment Regulations Section *307.178-179*

The seat belt law applies only to passenger vehicles, defined as a vehicle that is designed to transport 10 or fewer passengers. It requires seat belts for front seat occupants only and authorizes only secondary enforcement.

The Missouri Minimum Standards for School Buses includes a Side Intrusion Test[20] requirement that states the bus body shall be constructed to withstand an intrusion force equal to the curb weight of the vehicle; but shall not exceed 20,000 pounds, whichever is less. Similarly, Federal Motor Vehicle Safety Standard 221 - School Bus Body Joint Strength (Effective 4-1-77) establishes requirements for the strength of the body panel joints in school bus bodies. The purpose of this standard is to reduce deaths and injuries resulting from the structural collapse of school bus bodies during crashes

7. EMERGENCY RESPONSE

7.1 Initial Response

The Franklin County dispatcher was notified of the accident through the 911 system at 10:13 am. The first call from dispatch went out to the Boles Fire District at 10:14 am and their first unit with the Incident Commander (IC) arrived on-scene at 10:18 am. The Missouri State Highway Patrol (MSHP) was notified of the accident at 10:16 am and their first unit arrived on-scene at 10:31 am. The Meramec Ambulance District was notified at 10:15 am and their Lieutenant was first to arrive on-scene at 10:18 am. At 10:21 am the Lieutenant with the Meramec Ambulance District declared a Level 1 Mass Casualty Incident which automatically dispatches no less than 5 ambulances. The Boles Fire District responded with two engine units and three rescue units with the first rescue unit arriving at 10:21 am and the first engine unit arriving at 10:26 am, followed by another rescue unit at 10:28 am. The remaining two units arrived at 10:38 and 10:39 am.

At 10:23 am the IC requested all responding fire units to respond to the scene by traveling westbound on the eastbound lanes due to traffic congestion. EMS units were told to respond to the scene on the frontage road (American Inn south) in order to alleviate traffic on the interstate and facilitate transportation of injured.

Extrication of the surviving trapped occupant in the 2003 Bluebird was completed at 10:37 am and a secondary search for living victims was conducted on both school buses.

At 10:26 am the IC advised an arriving engine unit to lay down foam over a gasoline spill[21] from the pickup truck, which was under the 2003 Bluebird and lying atop the fifth wheel of the Volvo tractor. This task was completed at 11:01 am.

[20] Missouri Department of Elementary and Secondary Education, MISSOURI MINIMUM STANDARDS FOR SCHOOL BUSES , pg.18

[21] The Boles Fire Chief estimated the gasoline spill from the GMC pick-up truck to be between 10-20 gallons.

The IC instructed EMS to set-up triage near the frontage road for easier transport from the scene. Command requested at motorcoach to transport the 36 walking wounded to Cardinal Glennon Hospital and it arrived to transport at 11:02 am.

At 10:29 am the IC asked dispatch to contact Missouri Department of Transportation to close down I-44 at exit 247 and at 10:43 am eastbound traffic on the I-44 turnpike was closed and traffic was redirected off at the exit 247. Stopped traffic east of exit 247 was eventually turned around and directed back westbound on I-44 to exit 247.

Due to the configuration of the school bus on top of the GMC pickup and Volvo tractor, extrication of the deceased GMC driver was a prolonged process. Extrication began at approximately 1 pm with 2001 Bluebird being removed from the rear of 2003 Bluebird while wreckers stabilized the Volvo tractor and 2003 Bluebird. Crews removed the back wall of the bus and the rear seat in order to remove the deceased victim in the back of the 2003 Bluebird. The 2003 Bluebird was then removed from atop the pickup truck. In order to confirm that there were no other additional victims prior to moving the pickup truck; a wrecker was used to stabilize the pickup truck while still sitting on top of the tractors fifth wheel. Once this was confirmed, two wreckers had to pull apart the pickup truck in order to remove the victim inside. Extrication of the pickup truck driver started at 1:45 pm.

Due to extreme heat conditions on-scene, a rehabilitation area was set-up for first responders.

A total of 3 fire districts with 12 rescue and engine units and 6 ambulance services with 13 ambulances responded to the scene with 12 ambulances being utilized to transport 21 injured occupants.

An initial debriefing was held by the responding agencies the evening of the accident. No notes or documents were transcribed due to it being an informal debriefing only.

An informal Operational Critique was conducted between the Boles Fire District Chief and the Chief and Lieutenant from the Meramec Ambulance Service. The following issues were identified as areas that could have been handled more efficiently;

- Establishing and adhering to specific radio frequencies for specific sector traffic,
- Triage practices and use of Triage tags, to improve on accountability and transport records,
- Staging- attempt to have one entrance and one exit for transport units to avoid backing and passing each other, if possible, based on geographic location,

- Rehab/clean up- rotation of EMS crew due to long duration of event and heat factor
- Accountability for patients, all emergency service workers, and apparatus accountability,
- Accountability of civilians assisting with rescue prior to emergency services arriving,
- Additional training on emergency school bus hatch and window operations,
- Plan for possible additional emergencies with public stuck in traffic congestion for multiple hours.

7.2 Responding agencies

- Missouri State Highway Patrol
- Boles Fire Protection District
- Union Fire Protection District
- Pacific Fire Protection District
- Franklin County Sheriff's Department

Copies of the Brief Field Incident Reports (part of Attachment #3) for all the responding fire districts have been obtained and this information is included in this report.

Agencies that responded to the scene in order to transport injured passengers;

- Meramec Ambulance District;
- Eureka Fire Protection District EMS;
- Metro West Fire Protection District EMS;
- Big River Ambulance District;
- Washington Area Ambulance District; and
- St. Clair EMS

7.3 Franklin County Emergency Management Agency

The Franklin County's Standard Operating Procedures (SOP) for handling Mass Casualty Incidents (MCI) was requested. An NTSB review of the document revealed that the County only has a Disaster Plan as required by the Department of Homeland Security. The current Director of the Franklin county Emergency Management Agency is presently working on an MCI plan.

The Meramec Ambulance District Lieutenant, who was the first on-scene responder, called the MCI Level 1. The highest MCI level is a 5. According to documentation supplied by the Chief of the Meramec Ambulance District, each Level increase would call for an additional 5 ambulances to be dispatched to the scene.

Based on interviews with first responders, the incident was handled as a unified command with the MSHP doing the investigation of the accident, EMS units handling transportation of the injured, and the fire districts handling the rescue, extrication, and recovery efforts. All interviewed first responders commented that the rescue and recovery aspects went smooth and all the responding agencies worked well together.

8. MEDICAL AND PATHOLOGICAL INFORMATION

Table 3. INJURY ICAO[22] CODES[23]

INJURIES	DRIVER	PASSENGERS	TOTAL
FATAL	1	1	2
SERIOUS	1	4	5
MINOR	2	31	33
NONE	0	18	18
TOTAL	4	54	58

8.1 Injury Information

According to the non-invasive autopsy[24] reports, the deceased driver of the GMC pickup truck sustained multiple fractures to his skull, lower right leg, and lacerations and abrasions to the face, torso, and extremities. The deceased 15-year-old female school bus passenger sustained multiple fractures to the skull, chest, and extremities.

Based on the medical records obtained, the five seriously injured occupants' sustained hip, wrist, rib, tailbone, and vertebrae fractures. The driver of the 2001 Bluebird bus sustained serious injuries to her wrists while the other four seriously injured passengers were occupants in the 2003 Bluebird bus. The minor injuries consisted of neck strains, lip lacerations, bloody noses, contusions, and lacerations. All the occupants with no injuries complained of general soreness or headaches.

8.2 Hospital Information

The GMC pickup truck driver and the female passenger in the 2003 Bluebird school bus were pronounced dead at the scene of the accident by the Franklin County Coroner. Both of the deceased were transported to the St. Louis County

[22] International Civil Aviation Organization

[23] 49 CFR 830.2 defines a fatal injury as: any injury that results in death within 30 days of the accident. A serious injury as: an injury which requires hospitalization for more than 48 hours, commencing within seven days from the date the injury was received; results in a fracture of any bone (except simple fractures of the fingers, toes, or nose); causes severe hemorrhages, nerve, muscle, or tendon damage; involves any internal organ; or involves second or third degree burns, or any burns affecting more than 5 percent of the body surface.

[24] Non-invasive autopsies consisted of visual examinations and x-rays.

Medical Examiner's office where they had non-invasive autopsies conducted by the St. Louis Medical Examiner. According to the EMS IC, 21 occupants were transported by ambulance and 33 occupants were transported by a motorcoach to Cardinal Glennon Children's Hospital. All the school bus occupants, except two, were transported regardless if they claimed they were injured or not. The two that were not transported were released and departed the scene with their father who is affiliated with a fire department that did not respond to the accident. All occupants were evaluated at the five hospitals and were treated and released or transferred to higher trauma hospitals. Medical records have been obtained. The facilities are as follows:

St. Johns Mercy Medical Center St, Louis, Missouri 63141	SSM St. Clare Health Center Fenton, Missouri 63026
St. John's Mercy Hospital Washington, Missouri 63090	SSM Cardinal Glennon Children's Hospital St. Louis, Missouri 63104
Barnes-Jewish Hospital St. Louis, Missouri 63110	Missouri Baptist Hospital St. Louis, Missouri 63131
Franklin County Coroner	St. Louis County Medical Examiner

9 INTERVIEWS

Interviews were conducted with the Chief of the Boles Fire District who was the Incident Commander (IC), the Lieutenant of the Meramec Ambulance District, who was first to arrive on-scene and also the Deputy IC, the Paramedic that climbed into the 2003 school bus, the first firefighter/EMT that climbed into the school bus to start extrication of the entrapped passenger, the first Missouri State Highway Patrol Trooper and first Franklin County Sherriff's Deputy to respond, a civilian that climbed into the 2003 school bus and helped the female occupants evacuate, and a witness to the initial accident between the pickup truck and the Volvo truck tractor. In addition, interviews were conducted with thirty-eight[25] of the fifty-four passengers. For complete interviews refer to Attachments 1 and 2.

9.1 Interview Synopsis

Interviews with first responders resulted in the following comments;

- The EMS Lt. who was first to arrive on-scene said he immediately called in an MCI Level 1 that gave him no less than 5 more ambulances.
- The EMS Lt. told dispatch to send all responding ambulances to the south service road for staging in order to lessen the congestion on the Interstate and make it easy for them to transport the injured.

[25] Nineteen of the twenty-three girls in the 2003 Bluebird school bus and nineteen of the thirty-one boys in the 2001 Bluebird school bus. These interviews were conducted at St. James High School and are included as Attachments to this report.

- Extrication involved cutting several roof pillars and removing the back wall adjacent to the emergency exit door and cutting the back seat floor post of the 2003 Bluebird school bus.
- The IC instructed all the responding units to get to the scene by driving west down the eastbound lanes since the eastbound lanes were shut down.
- According to the Capt. responsible for the extrication, after assessing the trapped girl and seeing that her feet were free but her torso was pinned between the two seatbacks, he observed the deceased girl behind her also pinned between the two seatbacks.

Interviews with the witness to the impact between the GMC pickup and Volvo truck tractor and the civilian helper that climbed into the 2003 school bus resulted in the following comments;

- According to the witness, he was driving in the left lane traveling about 50 mph approaching the back of the GMC pickup truck when he happened to notice the pickup truck driver's head disappear like the driver was bending down to get something or leaning way over to the right reaching for something.
- He said he then noticed the bobtail tractor come to a stop and saw the GMC pickup impact the back of the tractor.
- According to the witness, he looked back in his right outside rearview mirror and saw the school bus hit the pickup truck and climb up the back of the bobtail tractor.
- When asked, the eyewitness said he did not see any brake lights from the GMC pickup prior to the collision with the bobtail tractor.
- The civilian helper that stopped several vehicles behind the accident said he ran to the first bus with the girls in it and saw that there were already 2 "guys" under the rear emergency window preparing to help the girls out the window. He said he jumped up and grabbed the window sill and pulled himself up into the bus.
- The first thing the civilian helper said he did was slide down the window in the row directly in front of the emergency window aisle and had a girl, that appeared to be slightly older and seemed relatively calm, reach out and hold the emergency window open so the other girls could crawl out.
- According to the civilian helper, he saw a girl trapped between two seatbacks and another girl on the floor. He said he pulled the girl up off the floor and helped her into a seat.
- According to the civilian helper, almost every girl exiting out that window got some piece of clothing snagged on the metal tab and it delayed the evacuation.

Interviews with school bus passengers resulted in the following comments;

- Some of the interviewed female passengers said they were talking just prior to the accident and all of a sudden they felt like that they were going upwards and they all started screaming.
- Others female passengers interviewed said they felt the bus swerve but thought they were hitting rumble strips on the shoulder but it kept getting worse and didn't stop.
- Other female passengers said they didn't realize anything happened until others on the bus started screaming and lots of girls stood up to see what happened.
- Most of the interviewed female passengers said that after the second impact, everyone was screaming until a couple of older girls told everyone to be quiet and started getting everyone prepared to exit out a window exit.
- The entire group of interviewed female passengers mentioned that a man got on the bus by crawling through a window and started helping them get out through the left rear emergency exit window.
- The entire group of interviewed female passengers mentioned that they could smell gasoline while waiting to get out and it made them nervous and anxious to get out of the bus as quickly as possible.
- Most all of the interviewed female passengers mentioned how almost every girl exiting out that emergency exit window got some piece of clothing snagged on the metal tab at the base of the window.
- Most all of the interviewed female passengers mentioned having had some type of emergency evacuation drills in grade school.

Attachments

1. Survival Group Attachment 1. First Responder, Witness, and Hospitalized Passenger Interviews
2. Survival Group Attachment 2. School Bus Passenger Questionnaire Interviews
3. Survival Group Attachments 3-10. Police, Fire, and Ambulance Logs and Reports
4. Survival Group Photographs (35)

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