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ON-SITE SCHOOL BUS INVESTIGATION

CASE NUMBER - IN08008
LOCATION - Minnesota
VEHICLE - 1999 THOMAS BUILT SCHOOL BUS
(ON AN INTERNATIONAL 3800 BUS CHASSIS)
CRASH DATE - February 2008

Submitted:

January 6, 2009



Contract Number: DTNH22-07-C-00044

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

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

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

Technical Report Documentation Page

1. <i>Report No.</i> IN08008		2. <i>Government Accession No.</i>		3. <i>Recipient's Catalog No.</i>	
4. <i>Title and Subtitle</i> On-Site School Bus Investigation Vehicle - 1999 Thomas Built School Bus Location - Minnesota			5. <i>Report Date:</i> January 6, 2009		
			6. <i>Performing Organization Code</i>		
7. <i>Author(s)</i> Special Crash Investigations Team #2			8. <i>Performing Organization Report No.</i>		
9. <i>Performing Organization Name and Address</i> Transportation Research Center Indiana University 501 South Madison Street, Suite 105 Bloomington, Indiana 47403-2452			10. <i>Work Unit No. (TRAIS)</i>		
			11. <i>Contract or Grant No.</i> DTNH22-07-C-00044		
12. <i>Sponsoring Agency Name and Address</i> U.S. Department of Transportation (NPO-122) National Highway Traffic Safety Administration National Center for Statistics and Analysis Washington, D.C. 20590-0003			13. <i>Type of Report and Period Covered</i> Technical Report Crash Date: February 2008		
			14. <i>Sponsoring Agency Code</i>		
15. <i>Supplementary Notes</i> On-site school bus investigation involving a 1999 Thomas Built School Bus.					
16. <i>Abstract</i> This report covers an on-site school bus investigation that involved a 1999 Thomas Built School Bus, a 1998 Plymouth Voyager, and a 2007 Chevrolet Silverado K1500 extended cab pickup truck. The focus of this on-site investigation was the sources of injury for the 4 fatally injured student bus passengers, the other injured passengers, and the structural damage to the bus' passenger compartment. The bus was occupied by a restrained 53-year-old male driver, 27 student passengers and one adult passenger, and it was traveling southwest on a state highway approaching a 4-leg intersection. The Chevrolet was traveling northeast on the highway and the Plymouth was traveling east on a county roadway approaching the intersection. The Plymouth entered the intersection and its front impacted the right side of the bus, which caused the bus to rotate clockwise. As the bus rotated, it entered the Chevrolet's travel lane and began to rollover and the front of the Chevrolet impacted the left side of the bus. Four student bus passengers sustained fatal injuries and 15 student bus passengers and one adult passenger were injured.					
17. <i>Key Words</i> School Bus Child Fatality			Motor Vehicle Traffic Crash Injury Severity		18. <i>Distribution Statement</i> General Public
19. <i>Security Classif. (of this report)</i> Unclassified	20. <i>Security Classif. (of this page)</i> Unclassified		21. <i>No. of Pages</i> 27	22. <i>Price</i>	

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This crash was brought to the National Highway Traffic Safety Administration's (NHTSA) attention on February 20, 2008 by news articles. The crash involved a 1999 Thomas Built school bus (on an International 3800 bus chassis, **(Figure 1)**, a 1998 Plymouth Voyager minivan, and a 2007 Chevrolet Silverado K1500 extended cab pickup truck. This on-site investigation was assigned on February 27, 2008. The crash occurred in February, 2008, at 3:25 p.m., in Minnesota and was investigated by the Minnesota State Patrol. The focus of this on-site investigation were the sources of injury for the 4 fatally injured student passengers and other injured passengers, and the structural damage to the bus's passenger compartment. This contractor inspected the vehicles and scene on March 4-5, 2008. This report is based on the police crash report, police on-scene photographs, inspections of the crash scene and vehicles, discussions with one of the investigating police officers, occupant medical records, an interview with the bus driver, exemplar Plymouth inspection, and this contractor's evaluation of the evidence.

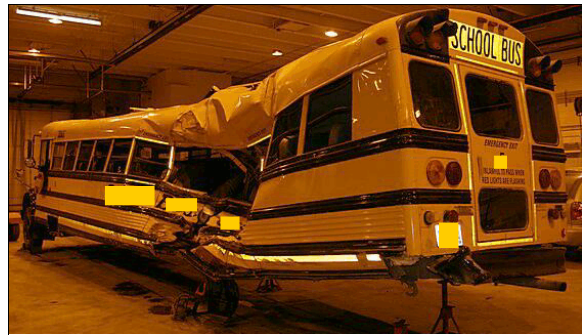


Figure 1: The damaged 1999 Thomas Built school bus

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the Thomas bus and Chevrolet were traveling was a 3-lane, undivided, state highway traversing in a northeast-southwest direction. The bus was traveling southwest approaching a four-leg intersection with a county roadway and the Chevrolet was traveling northeast approaching the same intersection (**Figure 2**). The trafficway on which the Plymouth was traveling was a two-lane, undivided, county roadway traversing in an east-west direction, and vehicle was traveling east approaching the intersection. The bus' and Chevrolet's roadways were level bituminous with one through lane in each direction, a right turn lane, and bituminous shoulders. Each lane and both shoulders were nominally 3.5 m (11.5 ft) in width. The pavement markings consisted of solid white edge lines, solid white right turn lane lines, a broken yellow center line for the Thomas bus, and a solid yellow center line for the Chevrolet. The Plymouth's roadway was bituminous with an eastbound and westbound lane, and gravel shoulders. The vehicle's roadway intersected a railroad grade crossing prior to its intersection with the state highway. The grade crossing was controlled by a railroad crossbuck sign, flashing light signal and automatic gate. The roadway was then controlled by a stop sign at the intersection with the state highway. The roadway grade was

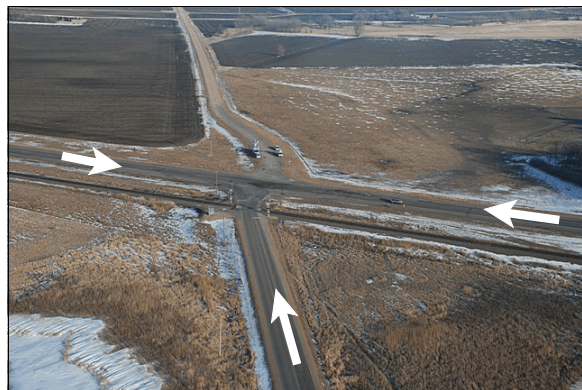


Figure 2: Police aerial photo showing view east along county roadway; left arrow shows Thomas bus' southwest approach to intersection, middle arrow shows Plymouth Voyager's east approach to intersection, right arrow shows Chevrolet Silverado's northeast approach to intersection

2% positive on the west side grade crossing and 3.6% negative on the east side of the grade crossing. The roadway grade then became 1.4% positive on the vehicle's easterly approach to the highway intersection. The mouth of the east leg of the county roadway was offset to the south (**Figure 2**). The posted speed limit for the school bus and the Chevrolet was 97 km.p.h. (60 m.p.h.). There was no posted speed limit for the Plymouth, but the statutory speed limit for rural Minnesota roadways was 89km/h (55 mph). At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry. Traffic density was light, and the site of the crash was rural. See the Crash Diagram on page 21 of this report.

Pre-Crash: The Thomas bus was occupied by a restrained 53-year-old male driver, 27 student passengers and one adult passenger. The bus was traveling southwest (**Figure 3**) approaching the intersection at a driver estimated speed of 89 km/h (55 mph), and the driver intended to continue southwest. The Chevrolet was traveling northeast (**Figure 4**) and was occupied by a restrained 46-year-old male driver, and he intended to continue northeast. The Plymouth was occupied by a restrained 24-year-old female driver and was traveling east approaching the railroad grade crossing and the intersection (**Figure 5**). The driver told police she was on her way to work and was due there at 4:00 p.m. This was her first time traveling on the county roadway. The driver of the Chevrolet and a witness who was traveling behind the school bus told police that the Plymouth was traveling at a high rate of speed and did not stop for the stop sign. The bus driver stated that he suddenly saw the Plymouth travel over the railroad grade crossing and did not have time to take any avoidance actions. The initial impact occurred within the intersection in the southwest lane.

Crash: The front of the Plymouth (**Figure 6**) impacted the right side of the Thomas bus [**Figure 7**, event 1 (note: The police would not allow



Figure 3: Thomas bus's southwest approach to intersection; arrow shows area of impact between bus and Plymouth



Figure 4: Chevrolet's northeast approach to intersection; left arrow shows area of impact between bus and Plymouth; right arrow shows area of impact between bus and Chevrolet

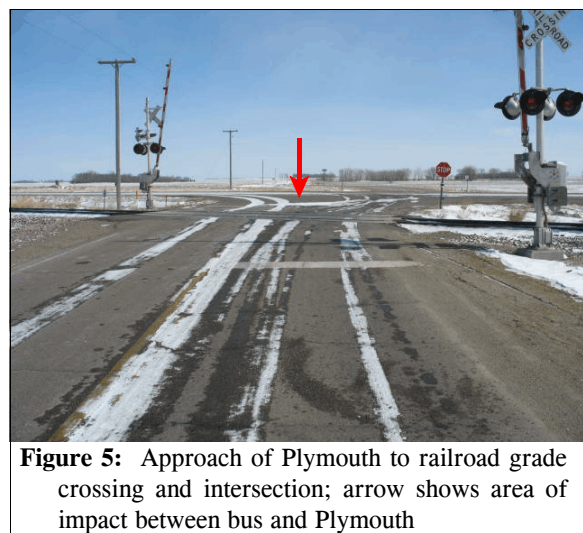


Figure 5: Approach of Plymouth to railroad grade crossing and intersection; arrow shows area of impact between bus and Plymouth

this contractor to remove the tarp that was covering the bus due to the wind velocity and the extent to which the tarp was secured over the bus. Most of the exterior photographs of the bus contained in this report were provided by the Minnesota State Patrol and are so noted in the figure captions)]. The impact occurred forward of the bus' right rear wheels and just rearward of the fuel tank (Figure 8). The forward extent of the direct contact was located 695 centimeters (274 inches) forward of the back of the bus. The damage to the Plymouth and the bus indicated that the front of the Plymouth underrode the side of the bus and engaged the bus' right frame member (Figure 8). The impact caused the Plymouth's front undercarriage to gouge the pavement, and the area of gouges was located in the center of the southwest lane. The impact caused the bus and the Plymouth to rotate clockwise and as the bus rotated it began to rollover (event 2) with the left side leading. The bus had rotated clockwise approximately 120 degrees and traversed a distance of approximately 27 meters (88.6 feet) when the front of the Chevrolet (Figure 9) impacted its left side (Figure 10, event 3) and left rear wheels (Figure 11). Since the bus was in the process of rolling over, the front of the Chevrolet engaged primarily above the bus' frame level, and the bus rolled onto the top of the Chevrolet (event 4, Figure 12). The center of the bus' left side crush pocket was located 361 cm (142 in) forward of the back of the bus.



Figure 6: Overview of damage to front of Plymouth from impact with right side of the Thomas bus



Figure 7: Police photo showing Plymouth's impact location on right side of bus (arrow)



Figure 8: Police photo showing contact to bus' right frame rail; arrow shows location of fuel tank



Figure 9: Damage to front of Chevrolet from the impact with the left side of the bus



Figure 10: Police photo showing damage to left side of bus from the impact with the Chevrolet



Figure 11: Damage to bus' left rear wheels from impact with the Chevrolet

As a result of its impact to the right side of the Thomas bus, the Plymouth rotated clockwise 295 degrees and came to final rest in the intersection in the southwest lane heading northeast (**Figure 13**). The Chevrolet and the bus remained engaged and rotated counterclockwise approximately 115 degrees and came to final rest with the bus on its left side on top of the front portion of the Chevrolet (**Figure 12**). The bus was partially on the northeast lane and right turn lane heading southwest, and the Chevrolet was on the right turn lane heading northwest (**Figure 14**).



Figure 12: Police on-scene photo showing rest position of Chevrolet under left side of bus

Post-Crash: A passer-by called 911 on her cell phone and notified authorities of the crash. The police, emergency medical and rescue services responded to the scene. The bus was equipped with two emergency roof exits and an emergency back door exit. The bus driver stated during the interview that he helped many of the students exit the bus through these exits with the assistance of passers-by and emergency responders. He estimated that 18 passengers exited through the forward emergency roof exit, 3 passengers exited through the emergency back door exit, and the twelfth row left window passenger crawled out of one of the left side windows. Two of the 4 fatally injured bus passengers were entrapped within the vehicle and were extricated by rescue personnel. partially ejected through a disintegrated left side window. The other 2 fatally injured bus



Figure 13: Police on-scene photo; view south to rest position of Plymouth, arrow shows pavement gouges from impact between Plymouth and bus, arrow in background shows rest position of bus

One of the entrapped passengers also was partially ejected through a disintegrated left side window. The other 2 fatally injured bus

passengers were also removed by rescue personnel. The remaining 2 passenger's means of exit is unknown.

Twelve of the injured bus passengers and 1 of the fatally injured passengers were transported by ambulance to a hospital. Two passengers were treated at the scene and 2 were treated at the scene and subsequently taken to a hospital by private conveyance. The remaining 8 passengers were not injured. The bus driver rode back to the bus terminal in another school bus and a bus service representative took him to a hospital for drug and alcohol tests, which he reported were negative. He was also examined by a doctor the following day and released. There was no alcohol or drug test ordered by the police. The Plymouth and Chevrolet drivers were transported from the scene by ambulance to a hospital. All of the vehicles were towed due to damage.

CASE VEHICLE

The school bus was manufactured by Thomas Built Buses Inc., in April 1999. The chassis was manufactured in 1999 by International (VIN: 1HVBBABPXXH-----), and the model was a 3800 4x2 FBC bus chassis (**Figure 15**). The bus was equipped with a NAVISTAR 446

CID diesel engine, hydraulic brakes and automatic transmission. Including the driver's seat, there were fourteen seating rows. Each passenger seat accommodated three passengers with the exception of the left seat in row 14, which accommodated two passengers. The passenger seats were not equipped with safety belt systems and the backs of each passenger seat back were padded.

CASE VEHICLE DAMAGE

Exterior Damage: The Thomas bus' initial impact with the Plymouth Voyager involved the right side of the bus forward of the right rear wheels and just rearward of the fuel tank (**Figure 8**). The direct damage began 695 centimeters (274 inches) forward of the back of the bus and extended rearward 250 centimeters (98 inches). The direct damage involved the sheet metal primarily at the bottom of the bus body; however, the bus' right frame member was also directly impacted as was the exhaust pipe. There was minimal crush to the bus body from this impact due to the height differential between the side of the bus and front of the Plymouth. As a result, the front of the Plymouth underrode the right side of the bus. The bus' left side impact with the Chevrolet



Figure 14: Police on-scene photo; view southwest to final rest position of Chevrolet and bus

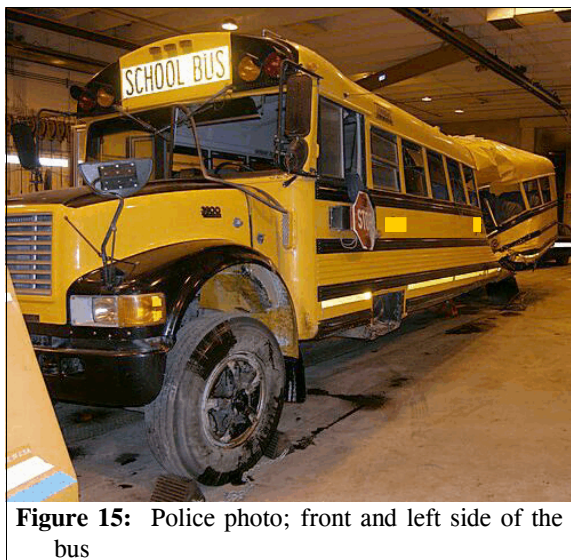


Figure 15: Police photo; front and left side of the bus

Silverado involved the side structure of the bus as well as the left rear wheels. The bus was rolling over to the left at the time of this impact, so the bus body was significantly engaged above the frame level (**Figure 16**). The direct damage began 217 centimeters (85 inches) forward of the back of the bus and extended 288 centimeters (113 in) forward along the side of the bus. The outer left rear wheel was directly impacted and broken off the rear axle, and the rear axle separated from the bus frame (**Figures 11 and 14**). The left side structure of the bus body was crushed inward to a maximum depth of 86 centimeters (33.8 inches). The maximum penetration occurred at the bottom of the side window adjacent to row 9. The sheet metal was torn apart in this area as a result of the impact (**Figure 17**) and the vertical frame members of the 4th-6th windows from the back of the bus separated from the side structure, and some of the rivets pulled through the sheet metal at the top of the same windows. There was minor direct damage along the left side of the bus due to the rollover. The engagement with the roadway pavement was minimal because the bus rolled on top of the Chevrolet.



Figure 16: Crush to left side of bus due to impact with Chevrolet; tape measure in tenths of meter



Figure 17: Sheet metal damage to left side of bus

Damage Classification: No damage classification could be assigned to the Thomas bus because it is outside the scope of the Collision Deformation Classification (CDC) and the Truck Deformation Classification (TDC) systems. The WinSMASH reconstruction program could not be used to determine the bus' Delta-V because buses are out of scope for the WinSMASH program. Based on the damage to the bus, the Plymouth, and the Chevrolet and considering the bus' larger mass, the bus' crash severity was estimated to be low [14-23 km/h (9-14 mph)] for the impact with the Plymouth and moderate [24-40 km/h (15-25 mph)] for the impact with the Chevrolet.

The manufacturer's recommended tire size was 11R22.5. The Thomas bus was equipped with tires of this size. The vehicle's tire data are shown in the table below. The pressure for the right rear outside tire could not be measured because the valve stem was damaged. The pressure for the right rear inside tire could not be measured because the valve stem was not accessible.

Tire	Measured Pressure		Vehicle Manufacturer's Recommended Cold Tire Pressure		Tread Depth		Damage	Restricted	Deflated
	kPa	psi	kPa	psi	milli-meters	32 nd of an inch			
LF	572	83	724	105	7	9	None	No	No
LR Outside	Flat	Flat	724	105	8	10	Bead separation	No	Yes
LR Inside	Flat	Flat	724	105	8	10	Bead separation	No	Yes
RR Inside	Unk	Unk	724	105	9	11	None	No	No
RR Outside	Unk	Unk	724	105	9	11	Sidewall abraded	No	No
RF	572	83	724	105	8	10	None	No	No

Vehicle Interior: Interior damage, intrusion (**Figures 18 and 19**) and/or occupant contact evidence were observed in the seating rows listed below. A schematic depicting the seating row configuration and row numbers is presented on page 22.



Figure 18: Left side intrusion into bus passenger compartment



Figure 19: Closer view of left side intrusion involving primarily seat rows 8-11

- Row 2 left: The top window was slightly ajar and the pillar slightly displaced.
- Row 3 left: The window glazing was cracked and the center horizontal frame member was bent outward due to occupant contact.
- Row 4 left: The bottom window glazing was disintegrated and the window's center horizontal frame member was slightly bent outward due to occupant contact. Dirt and blood were present on the roof side rail and ceiling.

- Row 5 left: The top and bottom window glazing was disintegrated and the center window's horizontal frame member was bent outward.
- Row 6 left: The side intrusion due to the impact by the Chevrolet Silverado began in this seating position. The top and bottom window glazing was disintegrated and the center horizontal frame member was slightly bent outward due to occupant contact. The side structure intruded 9 centimeters (3.5 inches).
- Row 7 left: The top and bottom window glazing was disintegrated due to damage. There was a blood smear on the roof side rail and forward window frame. The side structure intruded 28 centimeters (11 inches) and the roof was buckled. The seat back was deformed due to intrusion.
- Row 7 right: The roof was buckled and the side structure slightly deformed.
- Row 8 left: The top and bottom window glazing was disintegrated due to damage. The pillar was separated at the bottom and displaced rearward. There was a blood smear on the roof. The side structure intruded 65 centimeters (25.6 inches) and there was severe deformation to the seat due to the intrusion. The roof was severely buckled and intruded.
- Row 8 right: The bottom window glazing was disintegrated and the window's center horizontal frame member was slightly bent outward due to occupant contact. The side structure was slightly deformed and the roof was buckled. The seat was cut out of this position by rescue personnel.
- Row 9 left: The top and bottom window glazing was disintegrated due to damage. There was hair transfer on the window frame and blood smear on the roof side rail and the roof. The side structure intruded 75 centimeters (29.5 inches) and was torn apart vertically. The window frame separated from the side structure. There was severe deformation of the seat.
- Row 9 right: The top and bottom window glazing was disintegrated due to occupant contact and the window's horizontal frame member was slightly deformed due to occupant contact. The seat was cut out by rescue personnel. The floor was buckled upward and the roof was buckled.
- Row 10 left: The top and bottom window glazing was disintegrated due to damage. There was hair transfer on the pillar and heavy blood deposit on the roof. The pillar was separated from the side structure at the roof side rail. The side structure was intruded 84 centimeters (33.1 inches) and the roof was buckled and intruded.
- Row 10 right: The bottom window was disintegrated due to occupant contact. The floor was buckled upward and the roof was slightly buckled.
- Row 11 left: The top and bottom window glazing was disintegrated due to damage. The seat was severely deformed and the side structure was intruded 84 centimeters (33.1 inches) and the roof was buckled and intruded.
- Row 11 right: The floor was buckled upward.
- Row 12 left: The top and bottom window glazing are disintegrated due to damage. The seat back was deformed. The side structure intruded 15 centimeters (5.9 inches).
- Row 13 left: The top and bottom window glazing were disintegrated and the window's center horizontal frame member was bent outward due to occupant contact. The side structure was intruded 10 centimeters (3.9 inches).
- Row 14 left: Significant amount of blood on the side structure, roof side rail and roof. The roof was dented near the left roof side rail from probable occupant contact and there were scuffs on the back of the row 13 left seat.

The emergency roof exits were located above rows 4 and 11 and the size of the exit opening was 58 cm x 58 cm (22.8 in x 22.8 in). The emergency exits were manufactured by TRANSPEC Worldwide of Sterling Heights, Michigan and the model was Econo Safety Vent. The roof exit door above row 4 was slightly open at the front, but the door was still locked in place. The roof exit door above row 11 had been removed.

MANUAL RESTRAINT SYSTEM

The Thomas bus was equipped with a lap-and-shoulder belt in the driver's position, which consisted of continuous loop belt webbing, an Emergency Locking Retractor (ELR), locking latch plate and fixed upper anchor. Inspection of seat belt assembly revealed a load mark created by the locking latch plate in a location consistent with usage of the seat belt in the crash. The belt webbing also had a slight stretched appearance. The evidence indicated that the driver was restrained.

CASE VEHICLE INJURY INFORMATION AND KINEMATICS - OVERVIEW

There were 29 bus occupants, including the driver. Of the 4 fatally injured occupants, 3 were pronounced dead at the scene and 1 was transported. Three of the 15 occupants who were transported were subsequently transferred to another hospital. In total, 18 separate medical records required pursuit and 3 hospitals were identified as destinations for the injured occupants.

The applicable county medical examiner was contacted and autopsy/post-mortem records were requested for the 4 fatally injured occupants. The county medical examiner stated that no autopsies or post-mortem examinations were performed.

The two main hospitals that received the injured occupants would not honor this contractor's HIPAA requests. The third hospital did honor the HIPAA request and one of the occupant's medical records were obtained.

Seventeen medical record releases were prepared for the 14 remaining occupants. These occupants were identified as a part of 10 families and 6 other occupants were siblings of these 14 injured occupants. As a result, a total of 20 occupant questionnaires were prepared. Each of the 10 families were mailed a registered, return receipt requested envelope, containing a cover letter, an occupant questionnaire for each of the family's bus occupants, and a medical records release form for the medical facilities at which the occupant was treated. The vast majority of the families signed and returned the postal receipt indicating that the materials had been received. Only one family returned a signed medical records release and a completed occupant questionnaire for their child. In total, the medical records for only two of the injured occupants were obtained. As a result, the vast majority of the injury and occupant information identified below was obtained from the police investigation. The following sections addresses only the fatally injured occupants and those occupants where injury or other information was available. The police did not interview every occupant.

The occupants of the Thomas bus were subjected to crash forces related to three events in the crash sequence. Based on occupant kinematic principles, the initial right side impact with the Plymouth (event 1) would have displaced the occupants forward and to the right. As the bus rotated clockwise and began to rollover with the left side leading (event 2), the occupants would have been redirected to the left and toward the roof. The Chevrolet's impact to the left side of the bus (event 3) during the rollover would have accelerated the occupants to the left.

CASE VEHICLE DRIVER

The 53-year-old male driver of the Thomas bus was 183 cm (72 in) tall and weighed 109 kilograms (240 pounds). He was an employee of a bus service that was under contract to provide student transportation for the school system. He had driven this specific route for seven years. Of those seven years, four years were full time and three years were part time. Based on a document contained in the Driver/Vehicle Examination Report completed by the Commercial Vehicle Section of the Minnesota State Patrol, the bus driver had conducted a Type C (i.e., conventional bus) bus evacuation drill with students in December 2007.

The driver was seated in an upright posture with his back against the seat back, right foot and the accelerator and both hands on the steering wheel. During the crash sequence, he loaded the seat belt, which caused a contusion on his left shoulder and a back strain. The driver also sustained a neck strain, which was probably the result of impact force. The driver stated that following the crash a student and a band instrument were on top of him. The driver was examined in a doctors office the day following the crash and released. He developed pain in his neck and back 4 days following the crash. The table below shows the driver's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Strain, cervical {neck}, not further specified	minor 640278.1,6	Noncontact injury: impact forces	Probable	Interviewee (same person)
2	Strain, thoracic {back}, not further specified	minor 640478.1,7	Torso portion of safety belt system	Probable	Interviewee (same person)
3	Contusion {bruise} over left shoulder, not further specified	minor 790402.1,2	Torso portion of safety belt system	Probable	Interviewee (same person)

CASE VEHICLE SECOND ROW LEFT WINDOW PASSENGER

The second row left window passenger was a 7-year-old male. An 8-year-old male, who was not injured in the crash, was seated in the same seat with him. A padded partition separated this seat from the driver's seat. There was no discernable evidence of occupant contact in this seating row. This passenger was not transported but was treated at the scene for a bruised right knee and an abrasion on the right cheek, which he possibly sustained due to contact with the

padded partition during the Plymouth’s impact to the right side of the bus. The table below shows the passenger’s injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Abrasion right cheek, not further specified	minor 290202.1,1	Partition behind driver’s seat	Probable	Police Crash Report
2	Contusion {bruise} right knee	minor 890402.1,1	Partition behind driver’s seat	Probable	Police Crash Report

CASE VEHICLE SIXTH ROW LEFT WINDOW PASSENGER

The sixth row left window passenger was a 10-year-old male. He was sitting down facing forward. The occupant contact evidence indicated that the window passenger was displaced to the left during the rollover and the Chevrolet’s impact to the left side of the bus, and he loaded his left shoulder on the window’s center horizontal frame member. The contact bent the frame member out slightly and the passenger sustained a contusion and sprain of the left shoulder. This seat was located in the area where the left side passenger compartment intrusion began and the side structure intruded 9 centimeters (3.5 inches) into this passenger’s seat position. The passenger was treated at the scene and subsequently transported to a hospital. The table below shows the passenger’s injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Contusion {bruise} left shoulder, not further specified	minor 790402.1,2	Left side window, center horizontal frame member	Certain	Police Crash Report
2	Sprain left shoulder, not further specified	minor 751020.1,2	Left side window, center horizontal frame member	Certain	Police Crash Report

CASE VEHICLE SIXTH ROW LEFT AISLE PASSENGER

The sixth row left aisle passenger was an 8-year-old female. She was sitting on the seat facing forward. This passenger sustained lacerations on her head and knee ligaments, a contusion on an unknown leg, and fractured right ankle. No discernable occupant contact evidence was identified and the source of her injuries was unknown. The passenger was treated at the scene where her father picked her up and transported her to a hospital. The table below shows the passenger’s injuries.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Lacerations {cuts} on head, not further specified	minor 190600.1,9	Unknown injury source	Unknown	Police Crash Report
2	Laceration ligaments right knee, not further specified	minor 840404.2,1	Unknown injury source	Unknown	Police Crash Report
3	Contusion {bruise} on leg, not further specified	minor 890402.1,9	Unknown injury source	Unknown	Police Crash Report
4	Fracture right ankle in growth plate with torn ligaments, not further specified	moderate 852002.2,1	Unknown injury source	Unknown	Police Crash Report

CASE VEHICLE NINTH ROW LEFT PASSENGERS

The ninth row left seat was occupied by a 9-year-old male and a 9-year-old female. It is not known which seating positions these passengers occupied. This seat was directly in the area of the Chevrolet's impact and the side structure intruded laterally 75 centimeters (29.5 inches), and the sheet metal was torn apart vertically. The window frame also was separated from the side structure and there was severe deformation of the seat. Both of these passengers were fatally injured and entrapped. The male passenger was entrapped within the deformed seat and the female passenger was entrapped by the deformed side structure and window frame, and her right leg was ejected through the disintegrated glazing. Both passengers were pronounced deceased at the scene. Both passenger's fatal injuries were probably the result of loading the intruding side structure, which occurred when the Chevrolet impacted the left side of the bus. Hair transfer was found on the window frame and a blood smear on the left roof side rail.

CASE VEHICLE ELEVENTH ROW LEFT CENTER PASSENGER

The eleventh row left center passenger was a 10-year-old male. He was the only passenger in this seat and was sitting down facing forward. This seat was also directly in the area of the Chevrolet's impact and the side structure intruded 84 centimeters (33.1 inches). He sustained blunt head trauma, a lacerated liver, fracture with dislocation of his right hip, a fractured left femur, nerve damage of the left lower extremity, and lacerations and contusions on the head. While there was no discernable occupant contact evidence, the source of the passenger's head and left side injuries was probably due to contact with the intruding left side structure that occurred when the Chevrolet impacted the bus. The source of the fracture and dislocation of the right hip is unknown. The table below shows the passenger's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Blunt head trauma {concussion}, not further specified	unknown 115099.7,0	Left side window frame	Probable	Police Crash Report
2	Lacerations {cuts} on head, not further specified	minor 190600.1,9	Left side window frame	Probable	Police Crash Report
3	Contusion {bump} on head, not further specified	minor 190402.1,9	Left side window frame	Probable	Police Crash Report
4	Contusions lungs, bilaterally, not further specified	severe 441410.4,3	Left side interior surface, excluding hardware or arm-rest	Probable	Police Crash Report
5	Laceration liver, not further specified	moderate 541820.2,1	Left side interior surface, excluding hardware or arm-rest	Probable	Police Crash Report
6 7	Fracture and dislocation right hip, not further specified	moderate 850610.2,1 852600.2,1	Unknown injury source	Unknown	Police Crash Report
8	Damage nerve left lower extremity, not further specified	moderate 830699.2,2	Left side interior surface, excluding hardware or arm-rest	Probable	Police Crash Report
9	Fracture left femur, not further specified	serious 851800.3,2	Left side interior surface, excluding hardware or arm-rest	Probable	Police Crash Report

CASE VEHICLE TWELFTH ROW LEFT WINDOW PASSENGER

The twelfth row left window passenger was a 13-year-old female. She was the only passenger in this seat and was sitting down facing forward. She sustained a ligament laceration to an unknown leg. The side structure intruded 15 centimeters (5.9 inches) into this seat position and there was no discernable evidence of occupant contact in the seating area. The passenger told police that she exited the vehicle by crawling out of one of the side windows and laid on the pavement until she was taken to an ambulance. The table below shows the passenger's injury.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Laceration ligaments in leg ¹ , not further specified	moderate 840404.2,9	Unknown injury source	Unknown	Police Crash Report

CASE VEHICLE TWELFTH ROW RIGHT WINDOW PASSENGER

The twelfth row right window passenger was a 14-year-old male. He was the only passenger in this seat and was sitting sideways facing the aisle with his back against the side of the bus and his feet on the seat. He was talking with the thirteenth row left window passenger. There was no discernable occupant contact evidence or structural damage in this seating area and the seat remained intact. He sustained a concussion, lacerated lung, 6 fractured ribs, fractured lumbar spine, lacerated liver, a fractured hand, and a leg contusion. Based on occupant kinematic principles, he was ejected from the seat and probably loaded the roof, left seat(s), and left side of the bus during the rollover and the Chevrolet's impact to the left side of the bus. There was insufficient evidence to determine the specific contact source for each of his injuries. The table below shows the passenger's injuries.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Traumatic brain injury {concussion}, awoke in hospital, not further specified	unknown 115099.7,0	Unknown injury source	Unknown	Police Crash Report
2	Lacerated lung, not further specified	serious 441414.3,9	Unknown injury source	Unknown	Police Crash Report
3	Fracture six ribs, not further specified	serious 450230.3,9	Unknown injury source	Unknown	Police Crash Report
4 5	Fracture lumbar spine requiring vertebral fusion	moderate 650616.2,8 650606.2,8	Unknown injury source	Unknown	Police Crash Report
6	Laceration liver, not further specified	moderate 541820.2,1	Unknown injury source	Unknown	Police Crash Report
7	Fracture hand, not further specified	moderate 752500.2,9	Unknown injury source	Unknown	Police Crash Report
8	Contusion {bruise} leg, not further specified	minor 890402.1,9	Unknown injury source	Unknown	Police Crash Report

¹ For coding purposes, the lesion was assigned to the knee because no AIS code is provided for unknown location.

The thirteenth row left window passenger was a 15-year-old male, [168 cm and 52 kg (66 in, 115 lbs)]. He was the only passenger in this seat and was sitting down facing forward and talking to the twelfth row right window passenger. He sustained numerous injuries including a traumatic brain injury, left lung contusion, fracture of 4 left ribs, lacerated liver, lacerated kidney, and a ruptured spleen, which were probably the result of loading the left side structure during the Chevrolet's impact to the left side of the bus. The table below shows the passenger's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Traumatic brain injury with amnesia to events, not further specified	unknown 115099.7,0	Left side window frame	Probable	Police Crash Report
2	Abrasions face, not further specified	minor 290202.1,0	Left side window frame and glazing	Probable	Interviewee (relative)
3	Contusions {bruising} face, not further specified	minor 290402.1,0	Left side window frame and glazing	Probable	Interviewee (relative)
4	Contusion {bruised} lung, left, not further specified	serious 441402.3,2	Left side interior surface, excluding hardware or arm-rest	Probable	Interviewee (relative)
5	Fractured {broken} 4 left ribs, not further specified	serious 450230.3,2	Left side interior surface, excluding hardware or arm-rest	Probable	Interviewee (relative)
6	Lacerated liver, not further specified	moderate 541820.2,1	Left side interior surface, excluding hardware or arm-rest	Probable	Interviewee (relative)
7	Lacerated kidney, not further specified	moderate 541620.2,9	Left side interior surface, excluding hardware or arm-rest	Probable	Interviewee (relative)
8	Laceration {rupture} spleen, not further specified	moderate 544220.2,2	Left side interior surface, excluding hardware or arm-rest	Probable	Interviewee (relative)
9	Laceration, requiring repair, to small bowel, not further specified	moderate 541420.2,8	Bus seat back, twelfth row left	Possible	Interviewee (relative)

² According to the Interview Form the child was seated by the window; police indicated on aisle.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
10	Laceration, deep, left flank, not further specified	minor 590600.1,2	Unknown injury source	Unknown	Interviewee (relative)
11	Sprain left ankle, not further specified	minor 850206.1,2	Left side interior surface, excluding hardware or arm-rest	Probable	Interviewee (relative)
12 13	Fractured L ₅ and S ₁ vertebrae, requiring fusion, not further specified	moderate 650616.2,8 852600.2,6	Left side interior surface, excluding hardware or arm-rest	Probable	Interviewee (relative)

CASE VEHICLE THIRTEENTH ROW RIGHT UNKNOWN PASSENGER

The thirteenth row right passenger was a 13-year-old male. He was the only passenger in this seat and was seated in an unknown position. He sustained fatal injuries during the crash sequence. Based on occupant kinematic principles, he was ejected from the seat and probably loaded the roof and left side components of the bus during the rollover and the Chevrolet's impact to the left side of the bus. He was pronounced deceased at the scene.

CASE VEHICLE FOURTEENTH ROW LEFT WINDOW PASSENGER

The fourteenth row left window passenger was a 14-year-old male. He was the only passenger in this seat and was sitting down facing forward. He sustained a fracture with displacement of the right superior pubic ramus and a fracture of the right iliac bone. Based on occupant kinematics principles, the passenger was ejected out of the seat as the bus rolled over and when the Chevrolet impacted the left side of the bus during the rollover, he was redirected toward the roof and probably loaded the roof with the right upper right leg and hip. The roof was dented above this seat position near the left roof side rail. The passenger's injuries and injury sources are shown in the table below.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Wound {sore}, open, on lower back, not further specified	minor 690202.1,8	Unknown injury source	Unknown	Police Crash Report
2 3 4	Fracture with mild displacement right superior pubic ramus; fracture right iliac bone; widening right sacroiliac joint	serious 852604.3,5 852600.2,1 852800.3,6	Roof near left roof side rail	Probable	Emergency room records

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
5	Contusion {bruise} on posterior right upper leg, not further specified	minor 890402.1,1	Roof near left roof side rail	Probable	Police Crash Report
6	Abrasion left knee area, not further specified	minor 890202.1,2	Bus seat back, thirteenth row left	Probable	Emergency room records
7	Lacerations {cuts} on legs, not further specified	minor 890600.1,3	Unknown injury source	Unknown	Police Crash Report

CASE VEHICLE FOURTEENTH ROW RIGHT WINDOW PASSENGER

The fourteenth row right window passenger was a 12-year-old male. He was the only passenger in this seat. He sustained multiple head injuries and was transported to a hospital where he expired. Based on occupant kinematic principles, he was ejected from the seat and probably loaded the roof, left seat(s), and left side of the bus during the rollover and the Chevrolet's impact to the left side of the bus. There was insufficient evidence to determine a specific contact source for the head injury. The table below shows the passenger's injury.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Blunt, multiple, head trauma	unknown 115999.7,0	Unknown injury source	Unknown	Police Crash Report

1ST OTHER VEHICLE

The 1998 Plymouth Voyager was a front wheel drive mini van (VIN: 2P4FP25B1WR-----) equipped with a 2.4L, 4-cylinder engine and automatic transmission. The front row was equipped with bucket seats, lap-and-shoulder belts with adjustable upper anchors, and driver and front right passenger air bags. Both air bags deployed as a result of the Plymouth's front impact with the right side of the Thomas bus.

Exterior Damage: The Plymouth's impact with the Thomas bus involved the front of the vehicle (**Figure 20**). The direct damage involved the entire front structure of the Plymouth, including



Figure 20: Overview of damage to front of Plymouth from impact with right side of the bus

the windshield and both A-pillars, which sustained direct damage due to the vehicle’s underride of the right side of the bus. The front bumper had been torn off of the Plymouth during the crash and was not present at the inspection site. It was possible to take only two crush measurements, one at each end of the bumper brackets. Due to the underride, a second set of crush measurement was also taken at the upper radiator support level. The maximum residual crush occurred at the upper radiator support level at C₁ and was 99 cm (39 in). The table below shows the average of the two levels of crush.

Units	Event	Direct Damage		Field L	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	166	99	105	65	56	N/A	N/A	N/A	N/A	0	0
in		65.4	39.0	41.3	25.6	22.0	0.0	0.0	0.0	0.0	0.0	0.0

The Plymouth’s left side wheelbase was reduced 15 centimeters (5.9 inches) while the right side wheelbase was reduced 8 centimeters (3.1 inches). The induced damage involved the roof and the right front and right rear doors.

Damage Classification: The CDC for the Plymouth was **70-FDAA-7 (290 degrees)**. The 10 o’clock force direction was incremented by 60 because the vehicle’s end structure was shifted right 13 cm (5.1 in). The WinSMASH reconstruction program could not be used to reconstruct the Plymouth’s Delta-V because collisions with buses are out of scope for the program. The WinSMASH program was used to calculate a Barrier Equivalent Speed (BES) based on the vehicle’s front crush, and the BES was 85 km/h (53.4 mph).

The manufacturer’s recommended tire size was P205/75R14. The Plymouth was equipped with tires of this size and the vehicle’s tire data are shown in the table below.

Tire	Measured Pressure		Vehicle Manufacturer’s Recommended Cold Tire Pressure		Tread Depth		Damage	Restricted	Deflated
	kPa	psi	kPa	psi	milli-meters	32 nd of an inch			
LF	Flat	Flat	241	35	3	4	None	Yes	Yes
LR	165	24	241	35	6	7	None	No	No
RR	138	20	241	35	6	8	None	No	No
RF	Flat	Flat	241	35	4	5	None	No	Yes

Plymouths’s Driver: According to the police crash report, the driver of the Plymouth [24-year-old, female] was restrained by the lap-and-shoulder belt and sustained an A (incapacitating) injury.

2007 Chevrolet K1500 Silverado was a 4-wheel drive extended cab pickup truck (VIN: 2GCEK19J971-----) equipped with a 5.3L, V8 engine, automatic transmission, and 4-wheel anti-lock brakes. The front seating row was equipped with driver and front right passenger dual stage air bags and lap-and-shoulder belts with adjustable upper anchors and pretensioners. The Chevrolet was also equipped with an Event Data Recorder (EDR). The Chevrolet is certified by the manufacturer to be compliant to the Advanced Air Bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The Chevrolet’s driver air bag deployed as a result of its front impact with the left side of the Thomas bus. There was no front right passenger in the vehicle and the front right passenger air bag did not deploy.

Exterior Damage: The Chevrolet’s impact with the Thomas bus involved the front of the vehicle. The front bumper, both headlamp/turn signal assemblies and the hood were directly damaged. As the bus rolled onto the top of the Chevrolet the top of the hood, the windshield, both A-pillars and the roof also sustained direct damage (**Figure 21**). The direct damage involved the full width of the top plane and extended rearward to the middle of the front doors. The direct damage from the front impact began at the front left bumper corner and extended 150 cm (59 in) across the bumper. The crush measurements were taken at the bumper level and the maximum residual crush was 65 cm (25.6 inches) occurring at C₁. The table below shows the vehicle’s front crush profile.



Figure 21: Front left view of damage to the Chevrolet due to the impact with the left side of the bus

Units	Event	Direct Damage		Field L	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	3	150	65	150	65	62	53	48	33	28	0	0
in		59.1	25.6	59.1	25.6	24.4	20.9	18.9	13.0	11.0	0.0	0.0

The Chevrolet’s left side wheelbase was reduced 21 cm (8.3 in) while the right side wheelbase was extended 11 cm (4.3 in). Induced damage involved both fenders, the left front and left rear doors and the roof.

Damage Classification: The CDC for the Chevrolet’s front impact to the left side of the Thomas bus was **12-FDEW-3** (0 degrees). A second CDC was assigned to capture the damage to the top plane as a result of the bus rolling onto the top of the vehicle and was **00-TYDW-4**. The WinSMASH reconstruction program could not be used to reconstruct the Chevrolet’s Delta-V because collisions with buses are out of scope for the program. The Barrier algorithm of the

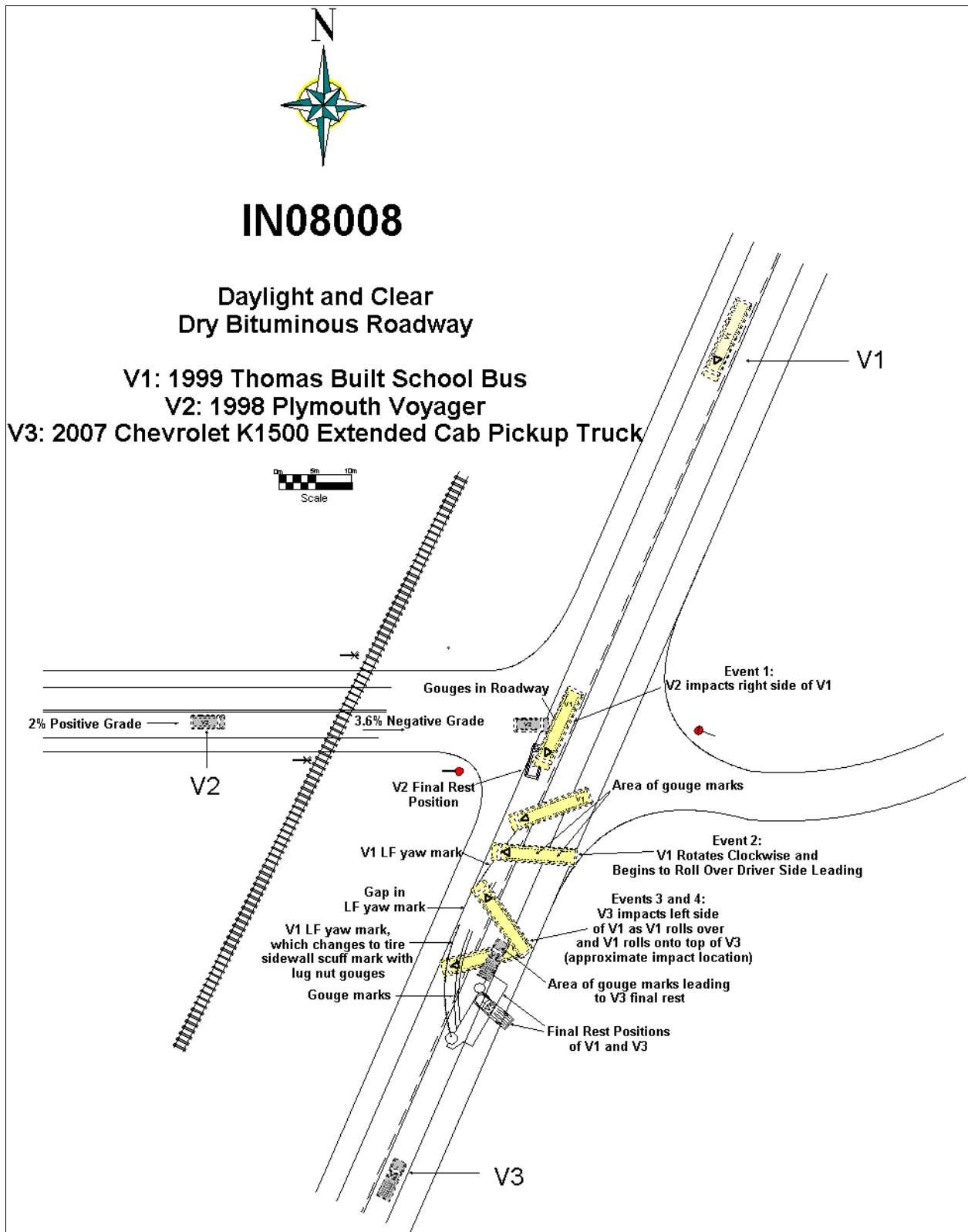
WinSMASH program was used to calculate a Barrier Equivalent Speed (BES) based on the front Chevrolet's front crush, and the BES was 59.0 km/h (36.6 mph). The Chevrolet's EDR recorded a maximum Delta-V of 86.1 km/h (53.5 mph).

The manufacturer's recommended tire size was P265/65R18. The Chevrolet was equipped with tires of this size and the vehicle's tire data are shown in the table below.

Tire	Measured Pressure		Vehicle Manufacturer's Recommended Cold Tire Pressure		Tread Depth		Damage	Restricted	Deflated
	kPa	psi	kPa	psi	milli-meters	32 nd of an inch			
LF	Flat	Flat	241	35	10	13	Cut sidewall	Yes	Yes
LR	221	32	241	35	10	12	None	No	No
RR	221	32	241	35	10	12	None	No	No
RF	221	32	241	35	10	12	None	No	No

Event Data Recorder: The Chevrolet's EDR was downloaded by the police using version 3.0 of the Bosch Crash Data Retrieval tool. The police provided a hard copy of the download to this contractor, which is presented on page 23. The EDR recorded a deployment event and the data indicated that the SIR warning lamp was off, the driver's seat belt switch circuit was recorded as buckled, and the driver's seat position switch was recorded as rearward. The first stage deployment criteria for the driver's air bag was met at 22.5 milliseconds following Algorithm Enable (AE), and the second stage deployment criteria was met at 25 milliseconds following AE. The longitudinal Delta V reached a value of -86.08 km/h (-53.49 mph) at the 230 millisecond point of recorded data, and the pre-crash data indicated that the vehicle was traveling 101 km/h (63 mph) 2.5 seconds prior to AE. The brake switch circuit was recorded on at 2 seconds prior to AE and remained on to the end of the pre-crash recording at 0.5 seconds prior to AE, where the vehicle's speed was recorded as 71 km/h (44 mph).

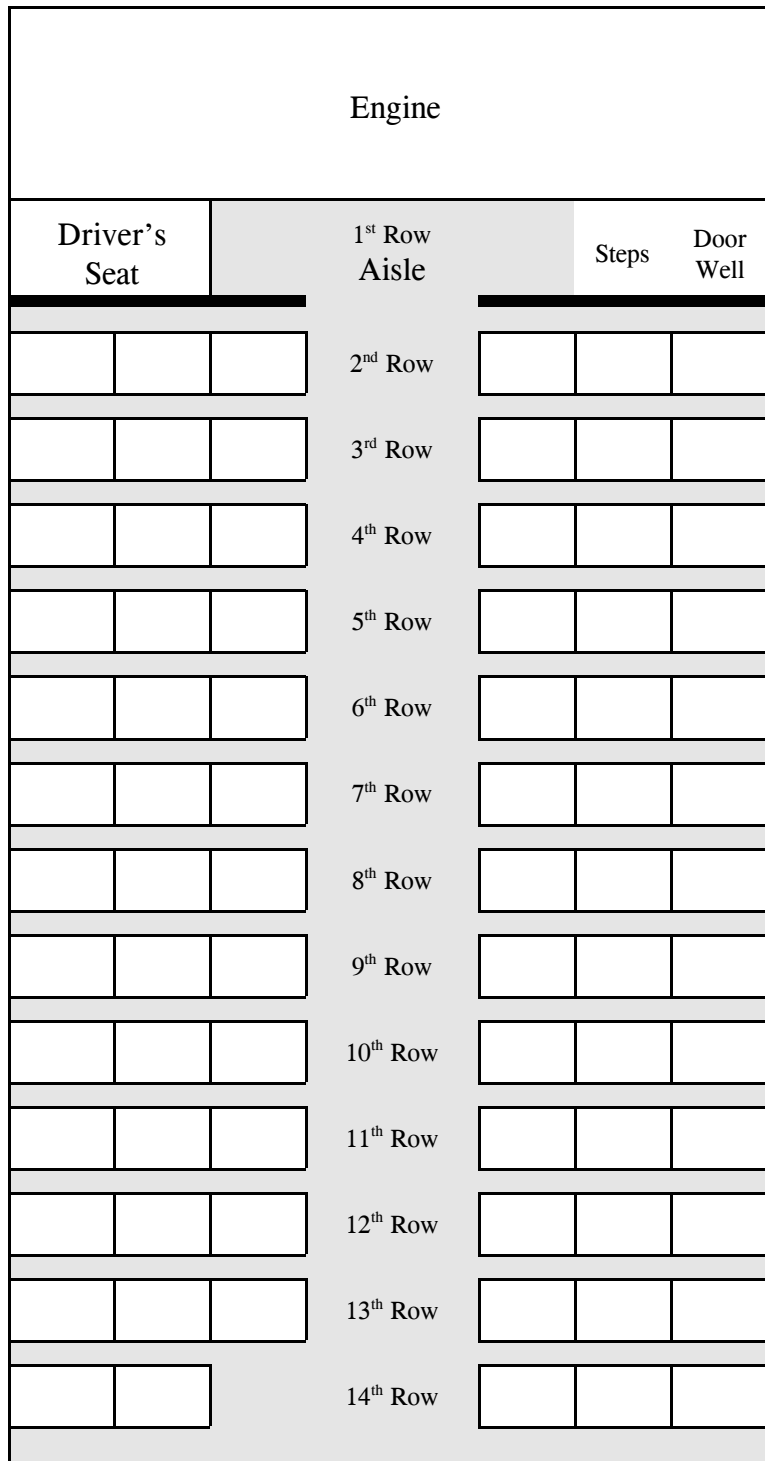
Chevrolet's Driver: The driver of the Chevrolet [46-year-old, male] was restrained by the lap-and-shoulder belt and sustained an A (incapacitating) injury.



SCHOOL BUS SEATING CONFIGURATION

IN08008

Shaded areas represent either an aisle or the area in front of a seat



↑
Rear Emergency Door

CDR File Information

Vehicle Identification Number	2GCEK19J971
Investigator	
Case Number	
Investigation Date	
Crash Date	
Filename	
Saved on	
Collected with CDR version	Crash Data Retrieval Tool 3.00
Reported with CDR version	Crash Data Retrieval Tool 3.00
EDR Device Type	airbag control module
Event(s) recovered	Deployment

Data Limitations**SDM Recorded Crash Events:**

There are two types of SDM recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event is an event severe enough to "wake up" the sensing algorithm but not severe enough to deploy the air bag(s). The minimum SDM Recorded Vehicle Forward Velocity Change, that is needed to record a Non-Deployment Event, is 5 MPH. It can contain Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event can be overwritten by a Deployment Level Event, if the Non-Deployment Event is not locked. This event will be cleared by the SDM, after 250 ignition cycles. The second type of SDM recorded crash event is the Deployment Event. It also can contain Pre-Crash and Crash data. The SDM can store up to two different Deployment Events. Deployment Events cannot be overwritten or cleared from the SDM. Once the SDM has deployed the air bag, the SDM must be replaced. The data in the Non-Deployment Event file will be locked after a Deployment Event, if the Non-Deployment Event occurred within 5 seconds before the Deployment Event. If a Deployment Level Event occurs any time after the Deployment Event, the Deployment Level Event will overwrite any non-locked Non-Deployment Event.

SDM Data Limitations:

- SDM Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Forward Velocity Change is the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change. For Deployment Events and Deployment Level Events, the SDM will record 220 milliseconds of data after deployment criteria is met and up to 70 milliseconds before deployment criteria is met. For Non-Deployment Events, the SDM will record up to the first 300 milliseconds of data after algorithm enable. The minimum SDM Recorded Vehicle Forward Velocity Change, that is needed to record a Non-Deployment Event, is 5 MPH.
- Maximum Recorded Vehicle Velocity Change is the maximum recorded velocity change in the vehicle's combined "X" and "Y" axis. It is calculated every 10 ms by taking the square of the "X" axis value and adding it to the square of the "Y" axis value and then taking the square root of the sum. The greatest calculated value is the one that is stored.
- Event Recording Complete will indicate if data from the recorded event has been fully written to the SDM memory or if it has been interrupted and not fully written.
- SDM Recorded Vehicle Speed accuracy can be affected if the vehicle has had the tire size or the final drive axle ratio changed from the factory build specifications.
- Brake Switch Circuit Status indicates the status of the brake switch circuit.
- Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if the SDM receive an invalid message from the module sending the pre-crash data.
- Driver's and Passenger's Belt Switch Circuit Status indicates the status of the seat belt switch circuit.
- The Time Between Non-Deployment and Deployment Events is displayed in seconds. If the time between the two events is greater than 5 seconds or the events overlap one another, "N/A" is displayed in place of the time. If the value is negative, then the Deployment Event occurred first. If the value is positive, then the Non-Deployment Event occurred first.
- If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.
- The ignition cycle counter relies upon the transitions through OFF->RUN->CRANK power-modding messages, on the GMLAN communication bus, to increment the counter. Applying and removing of battery power to the module will not increment the ignition cycle counter.
- Driver and Passenger Pretensioner Deployment Loop Commanded data will be displayed as "No", if they were the only restraint device commanded to be deployed in an event.

SDM Data Source:

All SDM recorded data is measured, calculated, and stored internally, except for the following:

- Vehicle Status Data (Pre-Crash) is transmitted to the SDM, by various vehicle control modules, via the vehicle's communication network.
- The Belt Switch Circuit is wired directly to the SDM.

Multiple Event Data

Associated Events Not Recorded	0
An Event(s) Preceded the Recorded Event(s)	No
An Event(s) was in Between the Recorded Event(s)	No
An Event(s) Followed the Recorded Event(s)	No
The Event(s) Not Recorded was a Deployment Event(s)	No
The Event(s) Not Recorded was a Non-Deployment Event(s)	No

System Status At AE

Low Tire Pressure Warning Lamp (If Equipped)	OFF
Vehicle Power Mode Status	Run
Remote Start Status (If Equipped)	Inactive
Run/Crank Ignition Switch Logic Level	Active

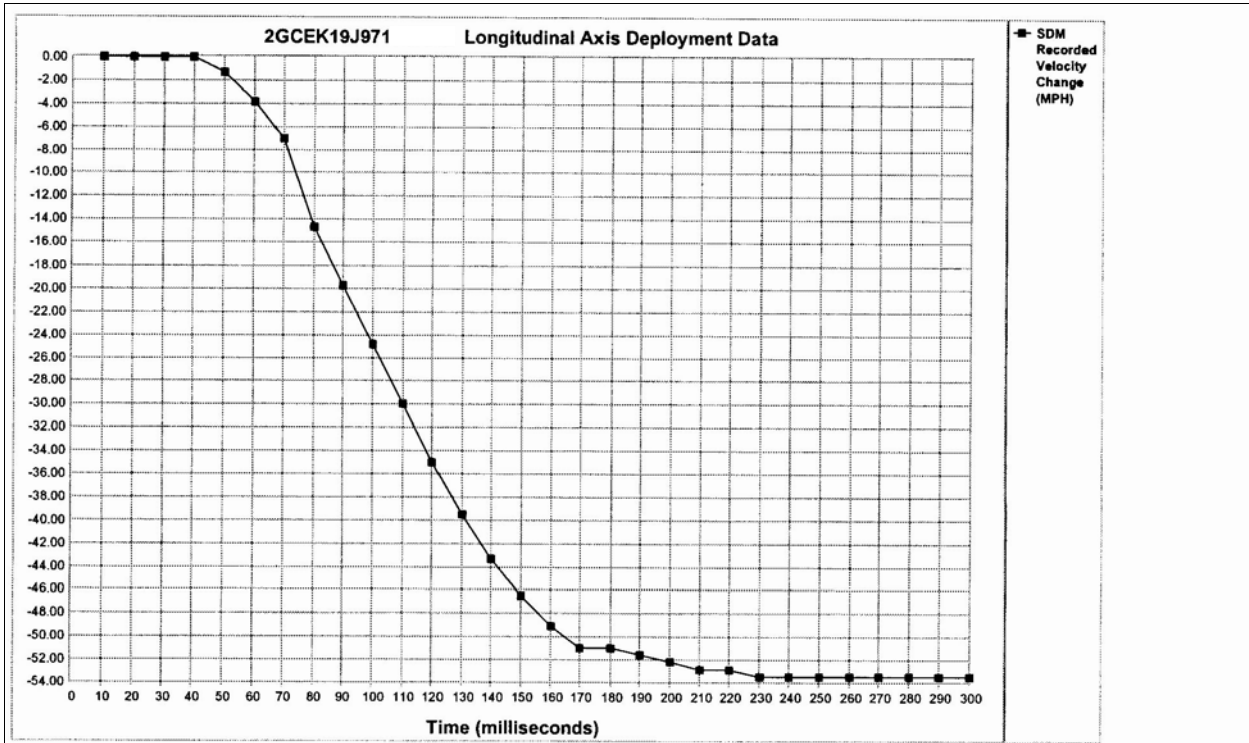
Pre-crash data

Parameter	-1.0 sec	-0.5 sec
Reduced Engine Power Mode	OFF	OFF
Cruise Control Active (If Equipped)	No	No
Cruise Control Resume Switch Active (If Equipped)	No	No
Cruise Control Set Switch Active (If Equipped)	No	No
Engine Torque (foot pounds)	173.15	171.12

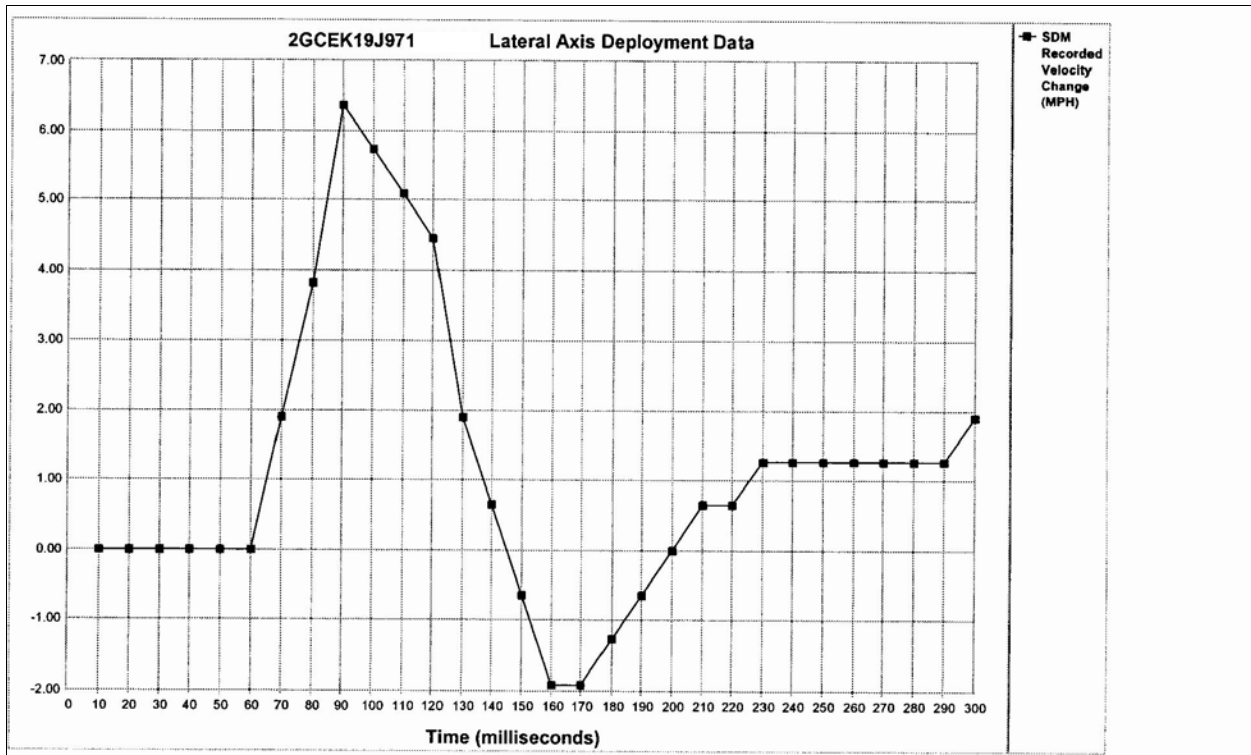
Pre-crash data

Parameter	-2.5 sec	-2.0 sec	-1.5 sec	-1.0 sec	-0.5 sec
Vehicle Speed (MPH)	63	62	57	51	44
Engine Speed (RPM)	1728	1728	1600	1408	1216
Percent Throttle	33	14	14	12	9
Brake Switch Circuit Status	OFF	ON	ON	ON	ON

System Status At Deployment	
Ignition Cycles At Investigation	1176
SIR Warning Lamp Status	OFF
SIR Warning Lamp ON/Off Time Continuously (seconds)	1200
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	0
Ignition Cycles At Event	1174
Ignition Cycles Since DTCs Were Last Cleared	255
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	UNBUCKLED
Driver Seat Position Switch Circuit Status	Rearward
Passenger Classification Status at Event Enable	Passenger Seat Empty
Current Passenger Position Status at Event Enable	Unknown
Previous Passenger Position Status at Event Enable	Unknown
Passenger Air Bag Indicator Status at Event Enable	OFF
Diagnostic Trouble Codes at Event, fault number: 1	N/A
Diagnostic Trouble Codes at Event, fault number: 2	N/A
Diagnostic Trouble Codes at Event, fault number: 3	N/A
Diagnostic Trouble Codes at Event, fault number: 4	N/A
Diagnostic Trouble Codes at Event, fault number: 5	N/A
Diagnostic Trouble Codes at Event, fault number: 6	N/A
Diagnostic Trouble Codes at Event, fault number: 7	N/A
Diagnostic Trouble Codes at Event, fault number: 8	N/A
Diagnostic Trouble Codes at Event, fault number: 9	N/A
Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	22.5
Driver 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	25
Passenger 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Suppressed
Passenger 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Suppressed
Driver Side or Roof Rail/Head Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Passenger Side or Roof Rail/Head Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Crash Record Locked	Yes
Vehicle Event Data (Pre-Crash) Associated With This Event	Yes
SDM Synchronization Counter	1174
Time Between Events (sec)	N/A
Event Recording Complete	Yes
Driver First Stage Deployment Loop Commanded	Yes
Passenger First Stage Deployment Loop Commanded	No
Driver Second Stage Deployment Loop Commanded	Yes
Driver 2nd Stage Deployment Loop Commanded for Disposal	No
Passenger Second Stage Deployment Loop Commanded	No
Passenger 2nd Stage Deployment Loop Commanded for Disposal	No
Driver Pretensioner Deployment Loop Commanded	Yes
Passenger Pretensioner Deployment Loop Commanded	Yes
Driver Side Deployment Loop Commanded	No
Passenger Side Deployment Loop Commanded	No
Second Row Left Side Deployment Loop Commanded	No
Second Row Right Side Deployment Loop Commanded	No
Driver (Initiator 1) Roof Rail/Head Curtain Loop Commanded	No
Passenger (Initiator 1) Roof Rail/Head Curtain Loop Commanded	No
Driver (Initiator 2) Roof Rail/Head Curtain Loop Commanded	No
Passenger (Initiator 2) Roof Rail/Head Curtain Loop Commanded	No
Driver (Initiator 3) Roof Rail/Head Curtain Loop Commanded	No
Passenger (Initiator 3) Roof Rail/Head Curtain Loop Commanded	No
Driver Knee Deployment Loop Commanded	No
Passenger Knee Deployment Loop Commanded	No
Second Row Left Pretensioner Deployment Loop Commanded	No
Second Row Right Pretensioner Deployment Loop Commanded	No
Second Row Center Pretensioner Deployment Loop Commanded	No



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Longitudinal Axis Recorded Velocity	0.00	0.00	0.00	0.00	-1.27	-3.82	-7.00	-14.64	-19.74	-24.83	-29.93	-35.02	-39.48	-43.30	-46.48
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Longitudinal Axis Recorded Velocity	-49.03	-50.94	-50.94	-51.57	-52.21	-52.85	-52.85	-53.49	-53.49	-53.49	-53.49	-53.49	-53.49	-53.49	-53.49



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Lateral Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	1.91	3.82	6.37	5.73	5.09	4.46	1.91	0.64	-0.64
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Lateral Axis Recorded Velocity Change (MPH)	-1.91	-1.91	-1.27	-0.64	0.00	0.64	0.64	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.91