



**SURVIVAL FACTORS GROUP CHAIRMAN'S
FACTUAL REPORT**

Chattanooga, TN

HWY17MH009

(21 pages)

**NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF HIGHWAY SAFETY
WASHINGTON, D.C.**

**SURVIVAL FACTORS GROUP CHAIRMAN'S
FACTUAL REPORT**

A. CRASH INFORMATION

Location: 300 block of Talley Road, Chattanooga, Hamilton County, Tennessee
Vehicle #1: 2008 Thomas Built School Bus
Operator #1: Durham School Services LP of Warrenville, IL
Date: November 21, 2016
Time: Approximately 03:20 p.m. Eastern Standard Time (EST)
NTSB #: **HWY17MH009**

B. SURVIVAL FACTORS GROUP

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C. CRASH SUMMARY

The crash involved a school bus occupied by the driver and 37 student passengers traveling from Woodmore Elementary School. The bus departed the roadway, overturned and collided with a tree.

For a summary of the crash, refer to the *Crash Summary Report* in the docket for this investigation.

D. DETAILS OF THE SURVIVAL FACTORS INVESTIGATION

The Survival Factors Group investigation collected evidence pertaining to the vehicles, the occupants, and the law enforcement and emergency response.

1. Thomas Built School Bus

The 2008 Thomas Built Bus was a model 1418S, with a total seating capacity of 84 passengers not including the driver. It was inspected at Yates Wrecker Service, in Chattanooga, Tennessee, on November 22, 2016. The bus was extensively damaged by the roll onto its right (passenger) side and impact with a utility pole and a large tree. The most severe damage was concentrated near the middle of the bus on the passenger side and roof, where the bus came to rest while engaged with the tree. A detailed exterior inspection of the school bus is documented in the Vehicle Factors Group Chairman's report, available in the accident docket.

The school bus was a Type D school bus, as defined by the National Congress on School Transportation (NCST).¹ It was a large, flat front bus with the engine at the front, positioned between the driver and loading area. The loading door was opposite to the driver at the front passenger side. Aft of the driver and loading door area, there were flat "privacy panels" on each side with an aisle down the center. There were 14 rows of bench style passenger seats, with one seat on each side, accommodating up to 3 students depending on occupant size, with no passenger seat belts. The passenger windows had a fixed lower pane with a vertically sliding upper pane. The bus was equipped with a video recording system, as described in section 1.4 of this report. Specifications, including general dimensions for the bus and the interior layout were obtained.²

1.1. Windows, Emergency Exits, and Roof

The bus had a two-pane windshield divided down the center. The glass from both windshield panes was broken out. Each windshield pane had nominal dimensions of about 38 inches high and 46 inches wide. The roof was crushed down at the front, and the post crash dimensions of the windshield opening measured 34 inches on the driver side and 40 inches on the passenger side.

There was a window next to the driver seat with two, horizontally sliding panes. The window measured about 30 inches square. The panes were found in the forward position with the glass intact, but the window frame was deformed at the top, bottom, and aft sides.

The loading door had two panels, each with two windows, with the glass in all panes broken out. The door was damaged and the door frame was deformed, with the forward panel displaced downward and aft. The loading door had a nominal opening of about 30 inches wide by 88 inches tall. The forward side of the loading door frame was crushed aft, and there was a buckle in the frame about 26 inches from the top, and 62 inches from the bottom. The post crash width of the

¹ NCST 2015 Specifications and Procedures, May 2015, Adopted by the 16th National Congress on School Transportation. <https://www.ncstonline.org>.

² SF Attachment 1: Thomas Built Bus Specifications.

loading door frame was about 26 inches wide at the top, 16 inches wide at the location between the two window frames, and 29 inches wide at the base.

The bus had 14 passenger windows along each side, all with a nominal height of about 29 inches high and 25.5 inches wide, except the most aft windows on each side, which were 36 inches wide. Three of the windows on each side functioned as emergency exits, with a frame that was releasable via a red handle mounted on the middle of the aft window frame. The emergency exit windows on the driver side were at passenger window numbers 3, 7, and 10; the passenger side emergency exits were at window numbers 4, 8, and 12.

The roof at the front two-thirds of the bus was crushed aft and downward, causing many of the window frames to be deformed. The driver side had significantly deformed window frames at numbers 1 through 10, and the passenger side had this deformation at the first 4 passenger windows. The next 7 window frames on the passenger side were completely dislodged or cut away. The last 3 window frames on the passenger side were not significantly deformed, and the glass was intact.

The bus had a rear emergency exit door at the center of the back, with a vertical hinge on the right side. The door was about 58 inches high by 34 inches wide, and had an interior opening of about 58 inches high by 30 inches wide. The door had an upper and lower glass panels which remained intact. The upper panel was about 20 inches high and 30 inches wide, and the lower was about 13 inches high and 30 inches wide. There were also fixed glass panels on each side of the door, about 20 inches square, both with the glass intact. The middle of the rear emergency exit door was a solid panel with a latch mechanism on the center of the driver side door frame. There was a white lever that extends horizontally from the latch when the door is closed. There was a black metal strip acting as a guard for the lever. To open the door, the lever was rotated clockwise 90 degrees. The rear exit door was not damaged in the crash.

The bus had 2 roof hatch emergency exit openings that measured about 22 inches square, located along the centerline of the roof. The front hatch was nominally in line with the fourth passenger window and the center was roughly 112 inches from the front of the bus. The rear hatch was nominally in line with the 12th passenger window and roughly 80 inches from the back of the bus. The interior width of the bus was 90 inches, and the distances from the sidewall to the nearest edge of the roof hatches were about 34 inches. The forward hatch was in an area of moderate roof crush, forward of the most severe intrusion. The hatch door was missing, and a hatch door was found nearby on the floor of the bus. Blood was found on the forward roof exit frame and on the hatch door. The rear hatch was in an area of minor roof crush, and the hatch door was missing.

The impact with the tree after the bus rolled onto its passenger side caused a large portion of the roof to crush into the passenger compartment. In order to document the crush and resulting space in the passenger compartment, measurements from floor to ceiling were taken at each passenger seat. In some areas the deformation resulted in a relatively small change from left to right across the bus. In these cases, only 1 measurement was taken at the middle of each seat. In other areas, where deformations were more abrupt, two measurements were taken, one near the inboard, and another near the outboard edge of the seat. These measurements were intended to characterize the available space, and thus the smallest distance (corresponding to maximum crush) in the general vicinity was used. Also, there was no attempt to measure localized variations in a

small area. The floor to ceiling measurements at each seat row are given in table 1. The nominal undamaged, maximum interior height of the bus from floor to ceiling was approximately 78 inches. Two measurements were taken across the width of the bus in the driver and loading door area, corresponding to the approximate center of the region. Four measurements were taken across the width of the bus at each passenger seat row, corresponding to the approximate center of each passenger seat and the inboard edge of each passenger seat.

Table 1: Floor to Ceiling Interior Measurements Due to Roof Crush (inches)

Row	Driver Area	64	(aisle)	Loading Door Area	63
1	70	70		67	67
2	67	67		63	63
3	64	64		56	49
4	59	59		53	44
5	51	49		40	40
6	46	42		38	34
7	42	39		37	35
8	38	35		35	26
9	45	NA (see note 1)		NA (see note 1)	NA (see note 1)
10	78	72		72	69
11	78	78		78	72
12	78	78		78	78
13	78	78		78	78
14	78	78		78	78

Note 1: This area of the bus had a severe buckle in the roof panel, precluding an accurate measurement.

1.2. Roof Crush Dimensions from 3-D Laser Scan

The school bus was documented using a 3-dimensional laser scanner.³ This technique created a 3-dimensional point cloud of the exterior and interior of the school bus. Measurements of the post crash bus were taken by selecting a cross-section or “slice” of data points at location corresponding to the seat and roof of the bus.

The following figure illustrates a longitudinal slice of the bus data points at a location 20 inches inboard of the right sidewall of the bus, and 2.5 feet wide. Note that the scanning equipment creates points on the surface of objects, and if the outside surface of the object is not included in the slice, there will be no points represented. The longitudinal slice shows some portions of the exterior and interior that fell within the above defined slice.

The data points of the slice were used to approximate the distance between the floor of the bus and the lowest portion of the roof in the vicinity of passenger seat rows 4 through 8 of the passenger side, as shown in Figure 1.

³ Refer to the Reconstruction Group Chairman’s Factual Report, in the NTSB docket.

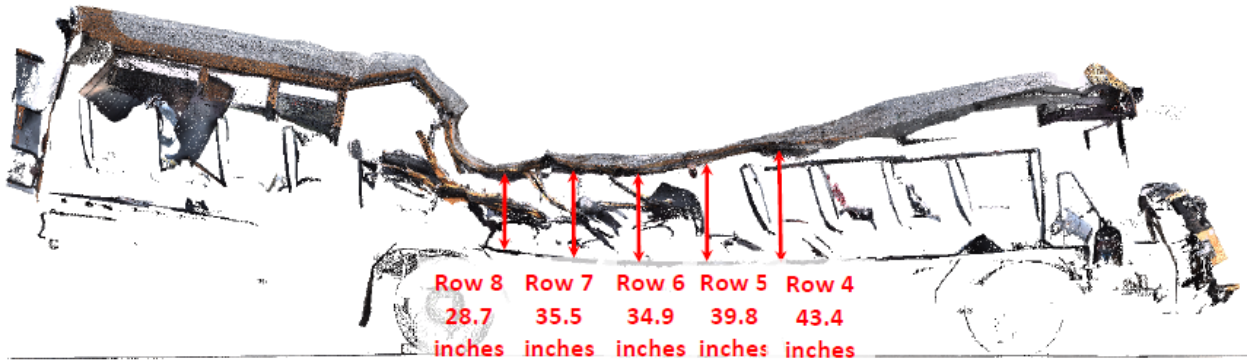


Figure 1: Longitudinal Cross-Section of the School Bus Laser Scan

Figures 2 through 5 shown below, illustrate lateral cross sections of the bus at the location of the passenger side seatbacks for rows 4, 5, 6, and 7 respectively. The slices were 4 inches thick. The dimensions from the top of the seatpan cushion to the lowest points of the roof crush were estimated as shown in the figures.

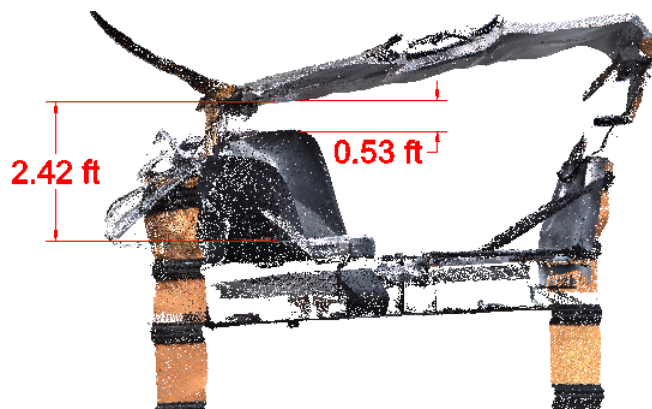


Figure 2: Lateral Cross-Section of the School Bus Laser Scan at Passenger Seat Row 4

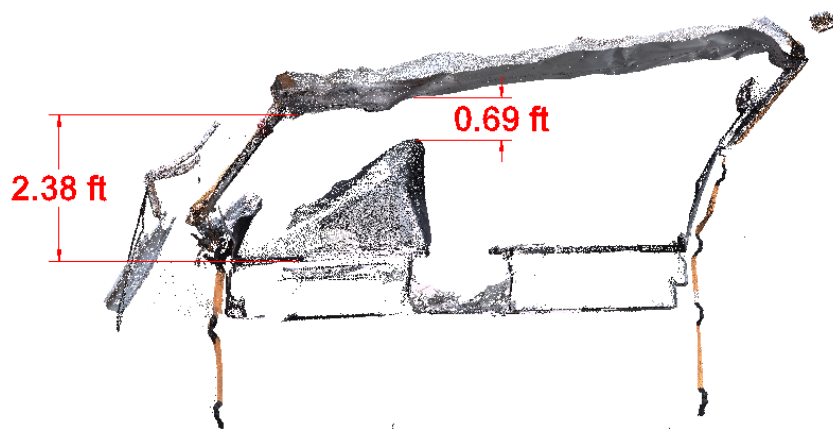


Figure 3: Lateral Cross-Section of the School Bus Laser Scan at Passenger Seat Row 5

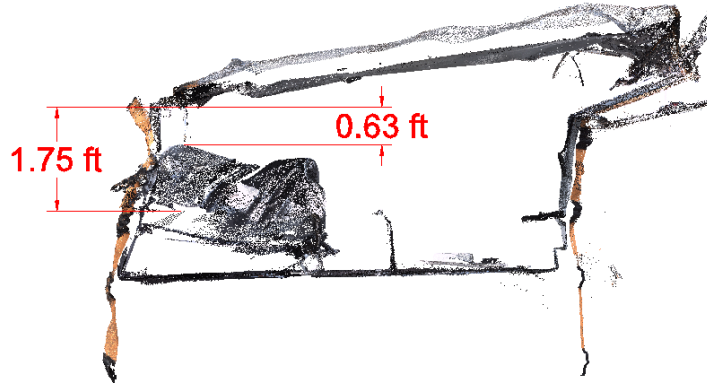


Figure 4: Lateral Cross-Section of the School Bus Laser Scan at Passenger Seat Row 6

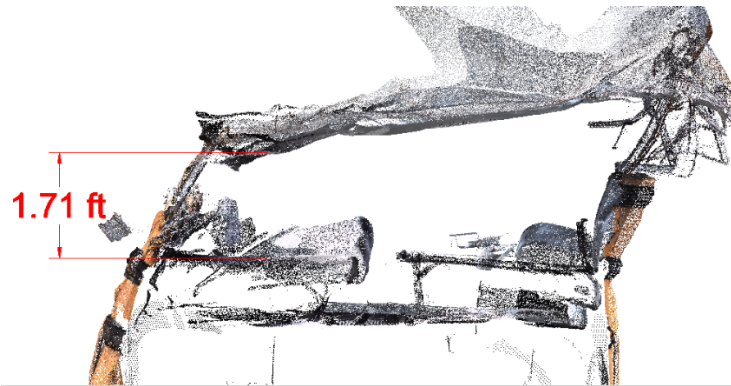


Figure 5: Lateral Cross-Section of the School Bus Laser Scan at Passenger Seat Row 7

1.3. Driver Seat, Loading Door and Entry Area

Damage in the driver seat area was concentrated at the front and roof. The forward and upper right portion of the bus was crushed inward (forward to aft), with the access of the loading door obstructed by deformation to the door. A child’s backpack was found hanging on a portion of the loading door frame with the name of passenger 3F found on materials inside.⁴ There was a small spot of blood found on the left side of the loading door frame near the top. Aft of the loading door a first aid kit, body fluids kit, and charged fire extinguisher were found mounted to the sidewall. At the front and center of the dashboard, a two way communications radio and Zonar GPS box were found. The ceiling at the location of the driver seat was 65 inches high. A video camera was mounted to the upper edge of the sidewall roughly in line with the driver seatback.

The driver seat was a suspended seat fitted with a 3 point restraint harness. The seatback was 19 inches wide at the base and 13 inches wide at the headrest, and 29 inches tall. The seatpan was 20 inches wide and 18 inches deep. The surface of the seatpan cushion was 24

⁴ The passengers were labeled according to their seat position, see section 2.3 for more information.

inches off the floor when unloaded. The driver seat belt was inspected and the connector was found unbuckled and at a location 24 inches from the seatbase anchor mounting location. The inertia reel was intact, but attempts to make it lock were unsuccessful. The buckle functioned appropriately. The steering wheel was not deformed. The dashboard was displaced aft several inches on the passenger side.

1.4. Passenger Seats

The passenger seats were fixed steel frame school bus seats with plywood/foam/vinyl seat cushions and seatbacks. There were 14 rows of seats on each side of the bus. Typical dimensions for each seat were measured as follows: the seat pitch was 17 inches and the top surface of the seat cushion was 28 inches; the seats were 39 inches wide; the seatback was 24 inches tall and the seatpan was 14 inches deep. The top of the seatbacks were about 44 inches from the floor. The passenger seats had labels on the seatpan frame that read “Syntec Inc. 06/21/07”, and the seats were described in the bus specifications (previously referenced) as “FMVSS Restraining Seat”.

The National Highway Traffic Safety Administration (NHTSA) published a final rule on October 21, 2008 that included changes to Federal Motor Vehicle Safety Standard (FMVSS) Number 222 which raised the minimum seatback height on large school buses to 24 inches.⁵ This rule also required lap/shoulder seat belt systems in school buses that weigh 10,000 pounds or less, which are manufactured after September 1, 2011. Several states have school bus passenger seat belt laws or are considering adopting requirements for seatbelts. Arkansas, California, Florida, Louisiana, New Jersey, New York, and Texas have passed some variation of a seat belt law for school buses but funding has not been appropriated in some states.⁶ In 2017, at least 29 states have introduced bills that would address seat belts on school buses, according to the National Conference of State Legislatures.⁷

There was damage throughout the interior of the bus, but with less damage at the front and back. The first 3 rows and last 5 rows of seats remained attached, while many of the middle rows were cut away by responders or crushed and in contact with the roof due to intrusion.

1.4.1. Passenger Seats – Rows 1 to 3

The privacy panels and the first 3 rows of seats remained in place but sustained damage. The privacy panel on the driver side was not deformed, and on the passenger side was crushed inward on the far right side by about 3 inches. The sidewall on the driver side seat row was buckled inward slightly, and the passenger side sidewall was crushed inward approximately 5 inches. On the passenger side floor of row 1, a backpack was found with the name of passenger 1F on materials inside. There was blood drips on the ceiling above the passenger side seat. The outboard side of the passenger seatback was deformed inward about 2 inches. In between the seatback and sidewall a broken section of a round wooden dowel was found that appeared to be from a broom handle.

⁵ Title 49 Code of Federal Regulations Part 571.222.

⁶ “The History of Seat Belt Development”, School Transportation News, STN Editor, August 7, 2017, <http://www.stnonline.com/the-history-of-seat-belt-development>.

⁷ School Bus Safety, <http://www.ncsl.org/research/transportation/school-bus-safety>.

There was a small amount of blood found on the center of the row 1 seatback in front of the driver side row 2 seat. The driver side seat cushion was flipped up, and the sidewall was deformed outward about 4 inches. The passenger side sidewall was deformed inward about 6 inches, and there was blood and hair on the top edge of the window frame. There was also glass and blood on the sidewall in this vicinity. A grey/silver backpack was found on the floor with the name of passenger 2F on materials inside. There was also a high top tennis shoe found on the floor. There was black dirt on the floor at the floor of the passenger side sidewall. The forward emergency exit windows were in the vicinity of row 2 and 3. On the driver side the exit window was closed, and on the passenger side the windows and window frames were heavily deformed and displaced.

The driver side of row 3 had a seat cushion from another seat resting on the seat cushion. This displaced seat cushion had blood and tissue on the inboard side. The row 3 seat on the passenger side did not have remarkable damage. The row 3 passenger side sidewall was crushed inward approximately 8 inches and the ceiling was crushed downward approximately 5 inches at the location of the window seat, and approximately 13 inches above the aisle seat. There were blood smears above the aisle seat. On the passenger side there was blood on the row 2 seatback (in front of the row 3 seat), on the floor, and on the sidewall. There were two backpacks found on the floor of row 3, one with the name of passenger 3C on the materials inside, and the other with the name of passenger 6C. There was also a blue/black shoe found under the seat.

1.4.2. Passenger Seats – Rows 4 to 6

Rows 4 to 6 had the roof crushed down to about the level of the seatbacks. On the driver side, the seatbacks were cut away and the base and seat cushion frames remained attached to the floor. On the passenger side, the seats remained in place with the roof and sidewall crushed onto them.

Row 4 on the driver side had the seatpan cushion displaced, and the seatback was cut off. A bus utility door panel labeled “battery” was sitting on the driver side seat frame. The passenger side had a seatpan cushion from another row resting on the seat cushion. This displaced seat cushion had a large fracture in the center of the plywood. There was a white shirt and a black shoe on the floor. There was blood, glass and dirt on the floor and on the sidewall. There was an orange folder on the seat with the name of passenger 6D. There was a section of a thick tree branch, about 4 inches in diameter stuck in between the seatback and sidewall.

The row 5 seatpan cushion on the driver side was flipped up, and the seatback was cut off. The passenger side row 5 had blood smears on the ceiling above the aisle seat and blood and tissue stuck to the ceiling above the window seat. The seatpan cushion was displaced to the floor. The brackets of the seatcushion were bent back and one was dislodged from its mounting. Large dried pools of blood, tissue, and bone were on the floor at the sidewall. The sidewall of the bus was ruptured open in this area. A black hightop shoe was found on the floor. The seatback at the window side was deformed back (as if reclined) to an approximate 60 degree angle. The sidewall was deformed inward about 15 inches

The row 6 seatpan cushion was missing and the seatback was cut off. The passenger side seatback was deformed aft to an approximate angle of 45 degrees. The sidewall was crushed

inward about 12 inches. There was a backpack found under the seat with the name of passenger 8F. There was a piece of a tree branch about 3 inch in diameter on the seat.

1.4.3. Passenger Seats – Rows 7 to 9

The row 7 driver side seat was completely cut away from the floor. A roof exit cover was found on the floor. The passenger side seatpan frame was crushed and cut in areas, with the seat cushion missing, and the seatback frame was cut away. The sidewall was crushed downward and inward about 12 inches, with wood, glass, and blood debris in the area.

The row 8 driver side seatpan frame was cut but remained in place, the seatback was cut and displaced. The row 8 passenger seat pan frame was crushed downward, and the sidewall was crushed inward about 18 inches. The passenger side seatback was cut but in place and the outboard corner was crushed inward about 10 inches. There was blood, tissue, and bone stuck in the upper aft corner of the window frame. A block of wood was also found on the seat. An approximately 4 inch diameter and 4 inch deep round indentation was found in floor in the aisleway, consistent with damage that could have been caused by a hydraulic jack. There were no obvious marks on the ceiling opposite this indentation.

The driver side row 9 seatpan cushion was displaced, and the seatback was cut. The seatpan and seatback were found in a pile of other parts in the vicinity of row 10.

1.4.4. Passenger Seats – Rows 10 to 14

The row 10 driver side seat was in place, but the seat cushion was displaced, and the corner of the seatback was deformed aft at the inboard corner about 2 inches. A peach colored piece of clothing was found on the seat. The row 10 passenger seat was in place and covered under a pile of other seat parts. There was a dark liquid stain on the seat and there was blood on the ceiling.

The row 11 driver side seat cushion was displaced onto the floor. The row 11 passenger side seat had a white and black tennis shoe and a backpack on the floor. The backpack had the name of passenger 14A on materials inside.

The row 12 driver and passenger side seat cushions were displaced and found on the floor. The driver side row 13 seat cushion was also displaced and found on the floor. The row 14 driver side seat cushion was missing and the passenger side seat had a section of bus exterior trim on the seat.

1.5. Video System

The school bus was equipped with a Seon school bus camera system. The system consisted of 3 cameras on the interior of the bus: 1) Side Camera with a view of the loading door, 2) Front Camera with a view from the front to the back of the bus, and 3) Back Camera with a view from the back of the bus forward. The camera system hard drive was obtained by the NTSB and taken to the NTSB laboratories for a forensic download. Refer to the Recorders Group Chairman's Factual Report available in the accident docket.

The Chattanooga Police Department and the school district generated AVI files with portions of the recorded video content. This content was reviewed by NTSB investigators and the staff from Woodmore Elementary School in order to identify the students, the order in which they boarded, and a description of how they were dressed. This information was used with an evaluation of the video to determine the seating position of the students on the bus just prior to the crash. The recorded video data also included information about the precrash, crash, and post crash events. These events were documented by conducting an evaluation of the video. Refer to the Onboard Image Recorder Specialist’s Factual Report, available in the NTSB docket.

2. Occupant Information

The crash involved the driver of the school bus and 37 student passengers. The following sections provide information about the driver and passengers based on autopsy reports or medical records obtained by subpoena. Table 2 summarizes the injury severity for those involved.

Table 2. Injury Table

Injuries⁸	Drivers	Passengers	Total
Fatal	0	6	6
Serious	0	6	6
Minor	0	20	20
None	1	5	6
Total	1	37	38

2.1. School Bus Driver Information

The school bus driver was a 24 year old male. Historical medical records (prior to the crash) for the driver recorded his height as 73 inches and weight as 148 pounds. After the crash, he was taken into police custody and was uninjured.

2.2. School Bus Passenger Information

The following sections list the passengers according to injury severity. The passenger’s age, gender, height and weight, and a summary of the injuries are given. Information about the Emergency Medical Services (EMS) prehospital care is included when available. The passengers are identified according to their seat position at the time of the crash, by listing the seat row number (1 to 14), and the seat position from the far left (window seat on the driver side), to the far right (window seat on the passenger side), labeled as A through F. Refer to section 2.3 for a complete seating chart.

⁸ Title 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.

2.2.1. Fatal

The deceased were taken to the Hamilton County Forensics Center at 3220 Amnicola Highway. Autopsies were performed on all fatal victims. Four of the victims were pronounced deceased on scene, and one victim was pronounced deceased the day of the crash at Erlanger Hospital (case number 16-216). A 6th victim (case number 16-219) was pronounced deceased at Erlanger Hospital on November 23, 2016.

Passenger 6A, was a 9 year old female. The Coroner's Case report number 16-216 identified the cause of death as multiple blunt force injuries. The report recorded a weight of 148 pounds and length of 59 inches. A summary of the injuries included head and neck injuries (branching fractures extending from the right anterior fossa across midline into the left anterior fossa and middle fossa) with multiple dicing and superficial incised wounds of the face, fractures of the skull and mandible; torso injury with bilateral fractures of ribs 1 and 2, lacerations of the subclavian vasculature, bilateral lung contusions, left scapula fracture, crushing laceration of spleen and liver; extremity injury with fracture of right humeral head, dicing injuries of forearms. There were artifacts of medical intervention which included surgical incisions for chest tube insertion, an intravenous catheter, and a surgical incision for vascular access in the right inguinal area, and an intraosseous catheter.

Passenger 6D, was a 10 year old female. The Coroner's Case report number 16-212 identified the cause of death as multiple blunt force injuries. The report recorded a weight of 112 pounds and length of 59.5 inches. A summary of the injuries included head and neck injuries with contusions and lacerations to the face and scalp, atlanto-occipital articulation laxity, facial and orbital petechiae; torso injuries with contusions to the posterior, abrasions of the lower back, petechiae of the heart and lungs, crushing lacerations of the liver and spleen; extremity injuries with lacerations and abrasions of the right arm and right knee, fracture of the right wrist, superficial lacerations and abrasions of the left hand and right knee.

Passenger 6F, was a 9 year old female. The Coroner's Case report number 16-214 identified the cause of death as multiple blunt force injuries. The report recorded a weight of 82 pounds and length of 56 inches. A summary of the injuries included head injuries with comminuted-compound skull fractures, multiple facial and scalp lacerations, partial avulsion of the brain; torso injuries with multiple dicing injuries, abrasions, and contusions, serial left rib fractures, bilateral lung contusions, heart and liver lacerations; extremity injuries with traumatic amputation of right forearm and hand, multiple lacerations of arms and legs, fracture of the right femur, fracture of the right metatarsals.

Passenger 7D, was a 6 year old male. The Coroner's Case report number 16-213 identified the cause of death as multiple blunt force injuries. The report recorded a weight of 49.5 pounds and length of about 49 inches. A summary of the injuries included head and neck injuries with comminuted-compound fractures of the entire skull, multiple facial and scalp lacerations, avulsion and fragmentation of the brain, neck laceration; torso injuries with diagonal linear crushing of the chest, fracture of the left clavicle, serial fractures of the right ribs, laceration of the right upper lobe of the lung, and multiple lacerations and abrasions of the right upper back; extremity injuries with laceration of the right shoulder with the humeral head exposed, multiple lacerations of the right

upper arm (continuation of the chest crushing), fractures of the right ulna, radius, and left femur, laceration of the right hand and posterior wrist, abrasions of the left knee.

Passenger 8B, was a 8 year old male. The Coroner's Case report number 16-219 identified the cause of death as multiple blunt force injuries. The date of death was November 23, 2016. The report recorded a weight of 70.5 pounds and length of 51 inches. A summary of the injuries included head and neck injuries with diffuse axonal injury, intracerebral hemorrhage from a massive contusion; torso injury with bilateral lung contusions, laceration of the cardiac right ventricle, crush lacerations of the liver and kidney with status of post embolization; right femur fracture.

Passenger 9F, was a 6 year old female. The Coroner's Case report number 16-215 identified the cause of death as multiple blunt force injuries. The report recorded a weight of 47.5 pounds and length of 49.5 inches. A summary of the injuries included head and neck injuries with multiple facial and scalp lacerations, abrasions, and dicing injuries, laxity of atlanto-occipital articulation; torso injury with torso compression and multiple contusions of the back, petechiae of the heart and lungs, laceration of the liver; extremity injury with multiple lacerations, abrasions, and contusions of the forearms, hands, and legs.

2.2.2. Serious

The passengers with serious injuries are listed below according to their seating position. Their age, gender, and height and weight (if provided in medical records) is also given. A detailed description of the sustained injuries is contained the Injury Group Chairman Factual Report, in the NTSB docket.

Passenger 2A, was a 7 year old male who suffered serious injuries. His medical records indicated that his weight was 60 pounds.

Passenger 5C, was a 8 year old male who suffered serious injuries. His medical records indicated that his weight was 75 pounds.

Passenger 5F, was a 8 year old male who suffered serious injuries. His medical records indicated that his weight was 66 pounds.

Passenger 7(aisle)⁹, was a 5 year old male who suffered serious injuries. His medical records indicated that his weight was 57 pounds.

Passenger 8F, was a 11 year old female who suffered serious injuries. Her medical records indicated that her height was 60 inches and weight was 141 pounds.

⁹ Video Evidence indicated that this child was standing in the aisle between the row 7 seats when the crash occurred.

Passenger 9C, was a 7 year old female who suffered serious injuries. Her medical records indicated that her weight was 79 pounds.

2.2.1. Minor and No Injuries

The passengers with minor and no injuries are listed below according to their seating position. Their age, gender, and height and weight (if provided in medical records) is also given. A detailed description of the sustained injuries is contained the Injury Group Chairman Factual Report, in the NTSB docket.

Passenger 1A, was a 8 year old female who suffered minor injuries. Her medical records indicated that her height weight was 62 pounds.

Passenger 1C, was a 5 year old female who was not injured.

Passenger 1D, was a 6 year old female who was not injured. Prehospital care records indicated her weight was 48 pounds.

Passenger 1F, was a 10 year old female who suffered minor injuries. Her medical records indicated that her weight was 86 pounds.

Passenger 2C, was a 7 year old male who suffered minor injuries. His medical records indicated that his weight was 60 pounds.

Passenger 2E, was a 8 year old female who suffered minor injuries. Her medical records indicated that her weight was 130 pounds.

Passenger 3A, was a 9 year old male who suffered minor injuries. His medical records indicated that his weight was 68 pounds.

Passenger 3C, was a 7 year old male who suffered minor injuries. His medical records indicated that his weight was 70 pounds.

Passenger 3E, was a 5 year old female who suffered minor injuries. Her medical records indicated that her weight was 46 pounds.

Passenger 4A, was a 8 year old male who suffered minor injuries.

Passenger 4C, was a 7 year old male who suffered minor injuries. His medical records indicated that his height was 48 inches and weight was 66 pounds.

Passenger 4E, was a 11 year old female who suffered minor injuries. Her medical records indicated that her weight was 75 pounds.

Passenger 5A, was a 7 year old male who suffered minor injuries. His medical records indicated that his height was 48 inches and weight was 53 pounds.

Passenger 5D, was a 10 year old female who suffered minor injuries. Her medical records indicated that her weight was 79 pounds.

Passenger 6C, was a 8 year old female who suffered minor injuries.

Passenger 9D, was a 6 year old male who suffered minor injuries. His medical records indicated that his weight was 53 pounds.

Passenger 10D, was a 10 year old male who was not injured.

Passenger 10F, was a 6 year old female who suffered minor injuries.

Passenger 11E, was a 8 year old male who suffered minor injuries. His medical records indicated that his weight was 77 pounds.

Passenger 12A, was a 9 year old male who suffered minor injuries.

Passenger 12E, was a 10 year old male who suffered minor injuries.

Passenger 13C, was a 10 year old male who suffered minor injuries. His medical records indicated that his weight was 99 pounds.

Passenger 13E, was a 10 year old female who suffered minor injuries. Her medical records indicated that her weight was 141 pounds.

Passenger 14A, was a 10 year old male who was not injured.

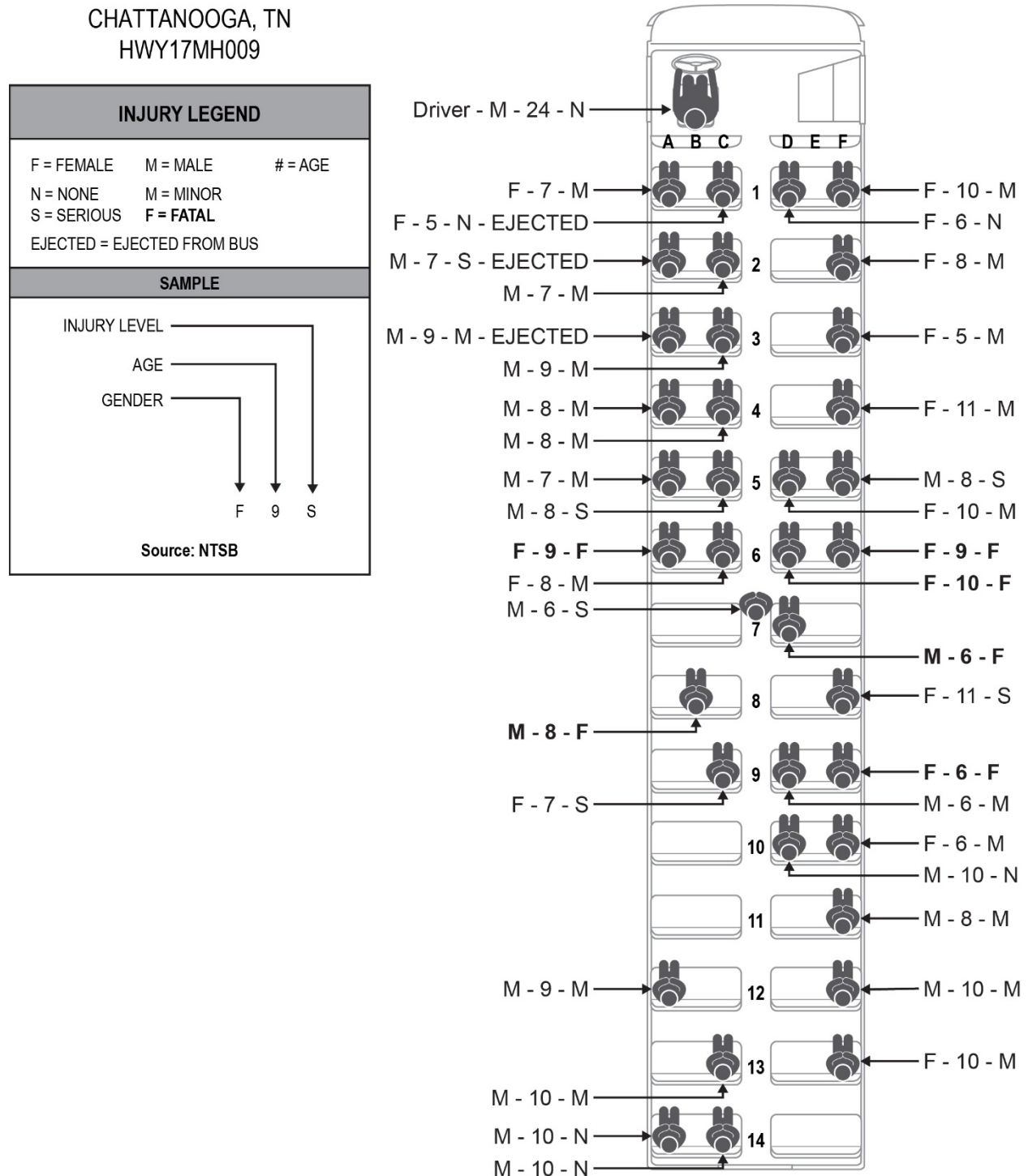
Passenger 14C, was a 10 year old male who was not injured.

2.3. Passenger Seating Location

The seat position of the passengers just prior to the crash was established based on the internal school bus video evidence. The process involved first identifying the passengers that boarded the bus, including making note of their clothing or other identifying features that were visible in the video. Each student's identity was also confirmed with help from the school staff. Second, the initial seating position was established, and then movements of students were noted

prior to the crash, with a final identification of the seat position just prior to the crash, as provided in Figure 1. Note that the passenger reference number corresponds to the number assigned in Section 2 of this report.

Figure 6: School Bus Seating Chart



3. Law Enforcement Information

3.1. Chattanooga Police Department (CPD)

The Chattanooga Police Department had primary jurisdiction for the crash. The crash occurred at about 3:20pm. Bystanders were onscene immediately, law enforcement and EMS were enroute within a minute of the emergency call, and fire/rescue was enroute within 4 minutes. The first EMS unit arrived onscene at 3:24 pm and the first law enforcement and fire/rescue units at 3:27 pm. The first patient transport occurred at 3:40 pm with the patient arriving at the hospital at 3:54 pm, extrication of all survivors was not complete until 5:17 pm with the patient transported at 5:21 pm and arrived at hospital at 5:30 pm.

The CPD incident detail report number 2016-11-26191 was obtained.¹⁰ This event log covered all aspects of the response, including law enforcement, fire, and EMS, and provides a complete list of responding units and response times. A summary of events documented in the log is provided in Table 3.

Table 3: Selected Events from the CPD Incident Detail Report

Note: Unit arrival times correspond to the time that the responder informed dispatch of their arrival.

<u>Time</u>	<u>Event</u>
3:20:25 pm	call picked up
3:21 pm	first CPD unit assigned
3:21 pm	reported that bus is overturned
3:21 pm	reported that EMS enroute
3:22 pm	reported to be a Multi-Agency EMS and Fire incident
3:22 pm	first fire unit assigned
3:22 pm	reported that bus had overturned
3:22 pm	reported that students were both inside and outside the bus
3:22 pm	reported severe injuries and fatalities
3:22 pm	reported that a power pole was damaged
3:23 pm	driver was identified as helping children off the bus
3:24 pm	first fire unit enroute
3:24 pm	report of victim entrapment and need to extrication
3:24 pm	EMS unit M11 arrived
3:27 pm	first CPD unit arrived
3:27 pm	first fire unit Q13CF arrived
3:29 pm	number of trapped victims was noted to be 5
3:30 pm	reported need for crowd control
3:30 pm	fire Battalion Chief unit B2B arrived
3:32 pm	EMS unit M07 arrived
3:33 pm	EMS unit M13 arrived
3:33 pm	fire unit S1CF arrived

¹⁰ SF Attachment 2: CPD Incident Detail Report.

3:37 pm fire unit S7CF arrived
 3:37 pm CPD reported that they have sufficient resources on scene
 3:38 pm noted that the Chattanooga Fire Department was working on extrication
 3:38 pm area for EMS staging was established
 3:40 pm EMS unit M07 transported patients from the scene
 3:42 pm fire unit 307CFD arrived
 3:42 pm fire unit 308CFD arrived
 3:43 pm fire unit S13CF arrived
 3:44 pm EMS unit M14 arrived
 3:45 pm fire unit Q7CF arrived
 3:46 pm fire Battalion Chief unit B3B arrived
 3:48 pm EMS unit M13 transported patients from the scene
 3:53 pm EMS unit M09 staged, (then on scene a minute later)
 3:54 pm EMS unit M07 arrived at hospital
 3:55 pm EMS unit M14 transported patients from the scene
 3:57 pm EMS unit M04 on scene
 3:59 pm EMS unit M13 arrived at hospital
 4:02 pm EMS unit M03 on scene
 4:06 pm EMS unit M14 arrived at hospital
 4:06 pm EMS unit M06 on scene
 4:09 pm note that bus investigation team enroute from Tennessee Highway Patrol
 4:11 pm family staging area was set up
 4:12 pm Medical Examiner was enroute
 4:19 pm bus driver was transported from the scene
 4:30 pm EMS unit M07 on scene
 4:33 pm EMS unit M07 transported patients from the scene
 4:40 pm report that 13 patients will be transported by bus from the scene
 4:41 pm EMS unit M07 arrived at hospital
 4:43 pm EMS unit M03 transported patients from the scene
 4:52 pm EMS unit M03 arrived at hospital
 4:59 pm update of EMS transport was received from Medcom
 4:59 pm report that 9 were transported by Hamilton County EMS
 4:59 pm report that 4 were transported from other EMS agencies, and 13 by bus
 5:04 pm report that 6 were transported by Memorial from Medcom
 5:14 pm previous report was corrected from 6 to 8
 5:16 pm reported that 1 student remained entrapped
 5:17 pm noted that the last extrication was completed
 5:21 pm EMS unit M04 transported patient from the scene
 5:30 pm EMS unit M04 arrived at hospital

There were 25 CPD units dispatched to the crash within 15 minutes, and 15 units on scene within 16 minutes of the call.

3.2. Tennessee Highway Patrol (THP)

The THP assisted with investigation of the crash.

4. Fire/Rescue Information

4.1. Hamilton County Public Service Answering Point and Dispatch Center

The Hamilton County 911 call center dispatched the law-enforcement, fire, and EMS services except for the Tennessee Highway Patrol.

4.2. Chattanooga Fire Department (CFD)

The City of Chattanooga Fire Department (CFD) had primary jurisdiction for fire/rescue operations. The CFD provided five pieces of apparatus, including two fire trucks and three rescue/squad units. Three Battalion Chiefs also responded to the scene. The first Battalion Chief to arrive assumed the role of Incident Commander (IC). The CFD incident detail report number 2016-11-26193 was obtained.¹¹ The call was picked up at 3:20:25 pm, the first unit was assigned at 3:22 pm, was enroute at 3:24 pm, and the first unit arrived at 3:27 pm. There was an indication of possible ejected passengers, that there were fatalities, and that there were approximately 20 injured victims at 3:22 pm. Individual events on the incident report are the same as those contained in the CPD log, which was summarized in section 3.1 of this report. The fire companies involved were interviewed.¹²

5. EMS

Hamilton County dispatched county EMS services as the primary EMS services agency. The incident detail report number 2016-11-26192 was obtained from Hamilton County was obtained.¹³ It indicated that the call was picked up at 3:20:51 pm. The CFD had 29 units respond to the crash. The first unit was assigned at 3:21:16 pm, was enroute at 3:21:25 pm, and arrived at 3:24:54 pm. The incident was closed at 8:34:27 pm. Individual events on the incident report are the same as those contained in the CPD log, which was summarized in section 3.1 of this report.

Some of the EMS responders were interviewed by NTSB investigators.¹⁴ The first non law enforcement responder to arrive was paramedic unit M11 from Hamilton County EMS, who was stationed nearby the scene. Unit M11 conducted a rapid assessment of the scene, reported the approximate number of patients and injury severities to the dispatcher. Members of the Chattanooga Police Department were already on scene and were helping to evacuate passengers.

The Hamilton County EMS supervisor was on paramedic units M07, the second to arrive on scene. Once arriving on scene he requested four additional trucks, declared a Mass Casualty Incident (MCI), and requested that all county supervisors and the State EMS District Supervisor be notified. The State District Supervisor (radio designation EMS 10), activated the county protocol for mutual-aid, and sent all available units to the scene, including privately contracted ambulances. Local hospitals were also notified.

¹¹ SF Attachment 3: CFD Incident Detail Report.

¹² SF Attachment 4: Witness Interviews.

¹³ SF Attachment 5: EMS Incident Detail Report.

¹⁴ SF Attachment 4: Witness Interviews.

6. Hospital Information

6.1. Erlanger Health System

The primary trauma center was Erlanger Hospital, a level 1 trauma center which included a children's hospital on the campus of the Erlanger Health System located at 975 E 3rd St., Chattanooga TN 37403. The hospital received 31 patients, 13 of which were triaged and "green" patients, and were transported by bus to the hospital. Two patients were pronounced deceased at the hospital.

6.2. Parkridge Health System

One patient was released at the scene and taken by private vehicle to Parkridge Health System located at 2333 McCallie Ave, Chattanooga, TN 37404.

E. SCHOOL TRANSPORTATION INFORMATION

School districts that use seat belts on their school buses were contacted in order to obtain feedback from their experiences. Input was solicited regarding both the school district and driver's perspectives. A range of responses from 6 school districts was obtained, including: Twin Rivers Unified School District (California), Orange County School District (California), Saint Lucie County (Florida), Clark Pleasant Community School Corporation (Indiana), the Nevada Department of Education (Nevada), Helena Public Schools (Montana).¹⁵

F. DOCKET MATERIAL

The following attachments and photographs are included in the docket for this investigation:

LIST OF ATTACHMENTS

SF Attachment 1: School Bus Information

SF Attachment 2: CPD Incident Detail Report

SF Attachment 3: CFD Incident Detail Report

SF Attachment 4: Witness Interviews

SF Attachment 5: EMS Incident Detail Report

SF Attachment 6: Responses from School Transportation on Experience with Seat Belts

¹⁵ SF Attachment 6: Responses from School Transportation on Experience with Seat Belts.

LIST OF PHOTOGRAPHS

- SF Photo 1 – School Bus Left Front View
- SF Photo 2 – School Bus Right Front View
- SF Photo 3 – School Bus Left Rear View
- SF Photo 4 – School Bus Right Rear View
- SF Photo 5 – School Bus Driver Area
- SF Photo 6 – School Bus Loading Door Interior View
- SF Photo 7 – School Bus Front of Passenger Cabin
- SF Photo 8 – School Bus Middle-Front of Passenger Cabin
- SF Photo 9 – School Bus Middle-Rear of Passenger Cabin
- SF Photo 10 – School Bus Rear of Passenger Cabin

END OF REPORT

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