

On-Site Tour Bus Investigation  
Dynamic Science, Inc. (DSI), Case Number DS08026  
2007 BCI Falcon 45 Tour Bus  
Nevada  
August 2008

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

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

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16. Abstract This on-site investigation focused on the tires that were installed on a 2007 BCI Falcon 45 tour bus. The bus was being used as a shuttle bus and was traveling northbound in the middle lane of three-lane interstate highway. There were 37 passengers on the bus. The left front tire experienced a tread separation and the vehicle veered to the left, crossed the inboard lane and concrete shoulder and struck a metal guardrail with its front left bumper (Event 1). As the guardrail yielded, the bus continued forward and struck a concrete barrier with its front right bumper (Event 2). According to the police report, 37 occupants including the driver were injured. A total of 30 passengers were transported, four to a Level I trauma center, six to Level II trauma centers, and 20 to various hospitals. Seven passengers were injured but not transported.				
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**Dynamic Science, Inc.**  
**Crash Investigation**  
**Case Number: DS08026**

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## Background

This on-site investigation focused on the tires that were installed on a 2007 BCI Falcon 45 tour bus (**Figure 1**). The bus was being used as a shuttle bus and was traveling northbound in the middle lane of three-lane interstate highway. There were 37 passengers on the bus. The left front tire experienced a tread separation and the vehicle veered to the left, crossed the inboard lane and concrete shoulder and struck a metal guardrail with its left front bumper (Event 1). As the guardrail yielded, the bus continued forward and struck a concrete barrier with its right front bumper (Event 2).



**Figure 1.** 2007 BCI Falcon bus

This on-site tour bus crash investigation was initiated by the National Highway Traffic Safety Administration (NHTSA) in response to an online news report. The article stated that 29 occupants were transported to hospitals, and that there was evidence of tire tread separation. DSI was assigned the case on August 12, 2008, and was instructed to locate the subject vehicle. On August 12, 2008, DSI contacted the investigating law enforcement agency and obtained permission to inspect the vehicle. The scene and vehicle inspections took place on August 14, 2008. The vehicle inspection took place at the bus owner's facility. Present at the vehicle inspection were the investigating police officers, a heavy vehicle expert from the police agency, a Michelin tire representative, a lawyer representing the bus owner, and a reconstructionist representing the bus owner. A police report with injury and tire information was obtained on January 29, 2009.

## SUMMARY

### Crash Site

This single vehicle crash occurred at 1850 hours in August 2008. The weather was clear and the concrete roadway was dry and free of defects. The temperature at the nearest reporting station was 37.2 degrees C (99 degrees F). The wind was blowing out of the west at 16 km/h (10 mph) and the relative humidity was 7%. The northbound roadway was configured with three lanes that were separated by raised ceramic reflector dots. The roadway was bordered on the left by a solid yellow line, a concrete shoulder, and a center divider. The roadway was level and the posted speed limit was 112 km/h (70 mph).



**Figure 2.** Northbound approach for the 2007 BCI Falcon bus

## Pre-Crash

The 2007 BCI Falcon tour bus was northbound and being driven by a 56-year-old male (**Figure 2**). The driver had a valid Nevada commercial driver's license. He had been working for the bus company for approximately 3 months. The bus was traveling in the middle lane of a three lane highway at a police reported speed of 89-105 km/h (55-65 mph). There were a total 37 passengers on board. The passengers were employees of a casino who were being shuttled back to their vehicles. The bus had traveled 111 km (69 miles) on this trip. The driver makes three trips a day along this route; the crash occurred during the first trip of the day.

## Crash

Occupants of the bus reported that they heard a tire blowout. Evidence of the tread separation in the form of a tire scuffmark was located on the left part of the center travel lane (**Figure 3**). This evidence was documented during the SCI scene inspection.

The driver reported that he felt the bus move downward in the front. The tire came apart and the bus traveled sharply to the left. The driver stated to the police that he did not brake because he learned in training that it would compound the problem. The bus veered to the left, crossed the inboard lane and concrete shoulder, and struck a metal guardrail with its left front bumper (**Figure 4**). The distance from the start of the scuffmark to the guardrail impact measured 92.5 m (303.5 ft). As the guardrail yielded, the bus continued forward an additional 21 m (68.9 ft) and struck a concrete barrier with its right front bumper (**Figure 5**).

## Post-Crash

The bus came to rest facing north the median (**Figure 6**). During the crash, several tires and undercarriage components were displaced from the vehicle. The right front wheel was fractured from



**Figure 3.** Area of tread separation



**Figure 4.** Area of impact, showing guardrail and concrete barrier (police photo)



**Figure 5.** Struck concrete barrier

the axle and came to rest east of the northbound roadway, approximately 73.2 m (240 ft) right of the vehicle. The second axle, brake assembly and inboard and outboard tires were displaced and came to rest on the paved shoulder, 4 m (13.2 ft) rearward of the vehicle's back end. The entire third axle with its left and right wheels fractured as a unit and came to rest 1.6 m (95.3 ft) rearward of the vehicle's back end.



**Figure 6.** Final rest (police photo)

According to the police report, 37 occupants including the driver were injured. A total of 30 passengers were transported, four to a Level I trauma center, six to Level II trauma centers, and 20 to various hospitals. Seven passengers were injured but not transported. The police did not list the seating positions for any of the occupants. Injury and interview data was obtained from 17 persons as shown in Table 1. An overview of the age/sex and injury status for the remaining occupants is illustrated in Table 2.

**Table 1. Overview of Occupant Injuries**

Occupant No.	Seat Location	Age/Sex	Injuries
01	Driver	56/Male	Non-incapacitating injury to the face
02	Towards front	72/Female	C5-C6 fracture subluxation with partial quadriplegia, facial laceration, left rib fractures.
03	Towards front	49/Female	Nasal fracture, facial and lip lacerations, and multiple contusions
04	Left side, towards front	58/Female	Lacerations, head and right arm
05	Row 3, right, window	43/Female	Contusion right thigh, shoulder, hip, forearm. Leg lacerations. Reported chest pain, amnesia, and elevated blood pressure.
06	Row 3, right aisle	26/Male	Bilateral leg lacerations, neck strain, and multiple contusions.
07	Left side, middle of bus, on aisle	25/Male	Multiple contusions.
08	Left side, middle of bus, on aisle	21/Male	Multiple contusions.

<b>Occupant No.</b>	<b>Seat Location</b>	<b>Age/Sex</b>	<b>Injuries</b>
09	Left side, near rear of bus, on aisle, above wheel well	44/Male	Head contusion and abrasion to right leg.
10	Left side of bus	39/Female	Fractured left clavicle and multiple contusions.
11	Left side of bus, towards rear	60/Female	Multiple contusions.
12	Unknown	29/Female	Neck and back strains.
13	Row 8, left side, on aisle	17/Female	Facial contusion (black eyes).
14	Right side of bus	51/Female	Facial contusions.
15	Row 4, left, window	61/Male	Facial contusions
16	Right side of bus	25/Male	Multiple contusions and lacerations.
17	Left side of bus, towards middle, aisle seat	24/Female	Forehead contusion.

**Table 2. Overview of age/sex/injury. Police Reported**

<b>Occupant No.</b>	<b>Age/Sex</b>	<b>Injury Severity (Police Reported)</b>	<b>Injury Location</b>	<b>Transport status</b>
18	57/Female	Non-incapacitating	Lower extremity	Hospital
19	46/Male	Non-incapacitating	Thorax	Hospital
20	49/Male	Incapacitating	Lower extremity	Hospital
21	64/Female	Claimed injury	Upper extremity	Hospital
22	53/Male	Claimed injury	Unspecified	Hospital
23	45/Male	Non-incapacitating	Head	Hospital
24	62/Female	Claimed injury	Lower extremity	Hospital
25	33/Female	Claimed injury	Unspecified	Level II trauma center
26	25/Male	Claimed injury	Spine	Hospital
27	54/Female	Non-incapacitating	Upper extremity	Hospital



<b>Occupant No.</b>	<b>Age/Sex</b>	<b>Injury Severity (Police Reported)</b>	<b>Injury Location</b>	<b>Transport status</b>
28	31/Female	Claimed injury	Unspecified	Not transported
29	19/Female	Claimed injury	Unspecified	Not transported
30	20/Male	Claimed injury	Upper extremity	Not transported
31	70/Female	Non-incapacitating	Head	Level II trauma center
32	59/Female	Incapacitating	Unspecified	Level I trauma center
33	54/Male	Incapacitating	Head	Hospital
34	59/Female	Claimed injury	Unspecified	Hospital
35	46/Female	Claimed injury	Lower extremity	Hospital
36	28/Female	Claimed injury	Unspecified	Not transported
37	61/Female	Claimed injury	Unspecified	Not transported

#### **Vehicle Data - 2007 Bus & Coach International (BCI) Falcon 45 Tour Bus**

The 2007 BCI Falcon Tour Bus was identified by the Vehicle Identification Number (VIN): LWECAD87Axxxxxx. It was manufactured in March 2007. The bus was 13.7 m (45 ft) in length and 2.6 m (8.5 ft) in width. The mileage was known to be 182,969 km (113,692 miles) prior to the beginning of the 111 km (69 mile) trip. The motor coach had a Gross Vehicle Weight Rating (GVWR) rating of 22,273 kg (49,000 lbs). The GVWR by axle is shown below:

Front: 7,750 kg (17,080 lbs)  
Intermediate: 12,000 kg (26,400 lbs)  
Rear: 7,750 kg (17,080 lbs)

The subject vehicle was equipped with a diesel engine, an Eaton Ultra Shift automatic transmission, a lift/lower suspension system, and anti-lock brakes with traction control. The bus was equipped with Michelin XZA2 Energy 315/80R/22.5 tires for all tire positions. The tires had a measured circumference of 338 cm (133 in). The tire manufacturer's maximum pressure was 896 kPa (130 psi). The vehicle manufacturer's recommended cold tire pressure was 827 kPa (120 psi) for the front axle, 793 kPa (115 psi) for the intermediate axle, and 827 kPa (120 psi) for the rear axle. The specific tire information was as follows:

Front (Axle 1, Left):

The tire sustained tread separation along the entire circumference (**Figures 7-8**). Five pieces of tread were recovered; the largest piece measured 24 cm (9.4 in) wide by 260 cm (102.3 in) in length. In descending order, the remaining pieces measured 14 cm (5.5 in) wide by 102 cm (40.1 in) long, 5 cm (1.9 in) wide by 126 cm (49.6 in) long, 10 cm (3.9 in) wide by 55 cm (21.7 in) long, and 8 cm (3.1 in) wide by 15 cm (5.9 in) long. It was estimated that 90% of the tread was recovered post-crash. The Tire Identification Number (TIN) for this tire was HAD7 B3JX 3806. The tire was manufactured in the 38<sup>th</sup> week (September) of 2006. The tire was flat and had a tread depth of 11 mm (14/32 in). The tire was restricted due to damage to the frame forward of the wheelwell.



**Figure 7.** Front axle 1, left tire



**Figure 8.** Tread from front axle 1, left tire

Front (Axle 1, Right):

The tire/wheel assembly had been fractured from the vehicle during the crash. The tire sustained a small gouge on the inboard sidewall that measured 15 cm (5.9 in). The tire had a measured pressure of 655 kPa (95 psi) and a tread depth of 11 mm (14/32 in). The TIN for this tire was HAD7 B3JX 3907. The tire was manufactured in the 39<sup>th</sup> week (September) of 2007.

Intermediate (Axle 2, Left Outboard):

This tire did not sustain any damage. The tire had a measured pressure of 648 kPa (94 psi) and a tread depth of 9 mm (11/32 in). The TIN for this tire was HAD7 B3JX 3907. The tire was manufactured in the 39<sup>th</sup> week (September) of 2007.

Intermediate (Axle 2, Left Inboard):

This tire did not sustain any damage. The tire had a measured pressure of 703 kPa (102 psi) and a tread depth of 8 mm (10/32 in). The TIN for this tire was HAD7 B3JX 4807. The tire was manufactured in the 48<sup>th</sup> week (November) of 2007.

Intermediate (Axle 2, Right Outboard):

Inboard/outboard wheel assembly was fracture from vehicle. The tire was undamaged. The tire was flat and had a tread depth of 11 mm (14/32 in). The TIN for this tire was HAD7 B3JX 4907. The tire was manufactured in the 49<sup>th</sup> week (November) of 2007.

Intermediate (Axle 2, Right Inboard):

The tire was flat and debanded with a superficial gouge to the inboard sidewall that measured 9 cm (3.5 in). The tire had a tread depth of 9 mm 11/32 in. The TIN for this tire was HAD7 B3JX 3907. The tire was manufactured in the 39<sup>th</sup> week (September) of 2007.

Rear (Axle 3, Left):

The wheel assembly was fractured from the vehicle. The tire did not have any visible damage. The tire had a measured pressure of 696 kPa (101 psi) and a tread depth of 12 mm (15/32 in). The TIN for this tire was HAD7 83JX 3907. The tire was manufactured in the 39<sup>th</sup> week (September) of 2007.

Rear (Axle 3, Right):

The wheel assembly was fractured from the vehicle. The tire was flat and there was a 9 cm (3.5 in) gouge to the outboard sidewall and a 47 cm (18.5 in) hole/tear to the inboard side wall. The TIN for this tire was TIN HAD7 B3JX 3907. The tire was manufactured in the 39<sup>th</sup> week (September) of 2007.

The 2007 BCI motor coach was configured to carry one driver (**Figure 9**), one front right passenger (**Figure 10**), and 56 additional passengers (**Figure 11**). Including the front left and right seating positions, there were a total 16 rows on the left side of the bus and a total of 14 rows on the right side of the bus. Each row was configured with two leather covered high back seats with adjustable footrests. The driver's seat was a pneumatic high back seat that was equipped with a lap belt. There was no evidence of lap belt usage in this crash. The front right guide seat was configured with a lap and shoulder belt. There was no evidence of belt usage in this crash.



**Figure 9.** Driver seat position



**Figure 10.** Front right seat position



**Figure 11.** Overview of seating, view from rear

## Vehicle Axle Data

Shortly after the crash, the state patrol conducted a survey that included a series of motor coach stops and axle weight measurements. The measurements were taken with the air suspension fully inflated and the brakes released. Seven of the buses stopped and tested were manufactured by BCI. For a number of the buses, the front axle weights varied to a considerable degree. If one side bore more weight than the other, the tire on the heavier side would tend to run hotter and have more wear—possibly leading to a tire tread separation. The weights recorded are shown in the following table.

**Table 2. State Patrol Axle Weight Survey**

Model Year	Left	Right
2008	3629 kg (8000 lbs)	1678 kg (3700 lbs)
2007	680 kg (1500 lbs)	4264 kg (9400 lbs)
2008	4218 kg (9300 lbs)	2223 kg (4900 lbs)
2008	3720 kg (8200 lbs)	2359 kg (5200 lbs)
2008	3130 kg (6900 lbs)	1905 kg (4200 lbs)
2008	3016 kg (6650 lbs)	2223 kg (4900 lbs)
2008	2631 kg (5800 lbs)	2586 kg (5700 lbs)

According to the police report, on September 10, 2008, BCI issued a recall (alert #PZ08I000899) for Falcon 45 Motor Coaches that stated, “transverse load can create increased axle load at one side causing tire wear, which could result in a crash.” It is not known if this issue was responsible for this crash.

## Vehicle Damage

### Exterior Damage - 2007 BCI Tour Bus

The 2007 BCI bus sustained severe damage from the impacts to the metal and concrete barriers (**Figure 12**). There was 240 cm (94.4 in) of direct damage distributed across the front end.

On the right side, the right front A-pillar base was deformed rearward 61 cm (24 in). The bottom base of the right front door measured 62 cm (24.4 in) in width; the width at the top was 81 cm (31.9



**Figure 12.** Right front damage



in). The B-pillar was deformed 17 cm (6.7 in) rearward. The right front door was torn from the vehicle. There were areas of scraping/cracking above the rear bumper at the right rear that was 13 cm (5.1 in) wide by 80 cm (31.4 in) high. Both rear axles had been fractured from the vehicle and the luggage area was torn open. The gear box was separated from the axle and was displaced to the left. The aluminum fuel tank had been penetrated and the fuel had escaped at the scene (**Figure 13**). The inverted V-shaped damage was to the forward right side of the tank and measured 41 cm (16.1 in) horizontally along the base and 35 cm (13.7 in) vertically.



**Figure 13.** Fuel tank damage

On the left side, the frame forward of the front axle was crushed rearward 27 cm (10.6 in) and restricted the left front tire. There was an area of direct contact located at the frame level that began at the left rear bumper corner and extended forward 310 cm (122 in).

On the back, there was a 40 cm (15.7 in) area of contact at the left rear bumper corner. The rear bumper fascia was cracked at a point 130 cm (51.2 in) from the left bumper corner.

#### **Interior Damage - 2007 BCI Tour Bus**

The 2007 BCI bus sustained moderate interior damage due to intrusion, loss of integrity, and occupant loading of components.

There was an area of floor intrusion between the driver and guide seat that measured 16 cm (6.3 in) vertically and 13 cm (5.1 in) longitudinally. There was a small amount of intrusion at the driver toe pan area. The floorboard in front of the right front seat position was torn away. The involved area measured approximately 74 cm (29.1 in) longitudinally and 90 cm (35.4 in) laterally. The measured area included the space between the driver and the right front seat. The right front door was torn from the vehicle.

The wiper lever had been broken off and blood was found on the steering wheel rim and hub. There was a spiderweb contact to the right side of the windshield with a blood deposit found at the base of the windshield. There was also blood located at the right B-pillar.

The front right passenger's window had disintegrated. On the left side, the exterior glazing to the 1<sup>st</sup> and 3<sup>rd</sup> windows was disintegrated and the exterior glazing to the 5<sup>th</sup> window was cracked.

There was damage and contact to various components of the rear seats that are described in Table 3. Examples of the damage and contact evidence are shown below (Figures 14-15).



**Figure 14.** Scuffing and seat back movement



**Figure 15.** Facial contact to seat back

**Table 3. Damage and contacts to rear seats**

***Left Seats***

Seat Location	Damage	Seat Location	Damage
Row 1 left			
Row 2 left	The divider was deformed forward 10 cm (3.9 in).	Row 2 right	The seat back deformed forward 55 cm (21.7 in).
Row 3 left		Row 3 right	A scuff was located on the headrest.
Row 4 left		Row 4 right	
Row 5 left		Row 5 right	There was makeup located from a facial contact on the rear of the headrest. There was also a scuff located and a trail of blood from headrest to seat back.
Row 6 left		Row 6 right	
Row 7 left		Row 7 right	A scuff was located at the center of headrest
Row 8 left		Row 8 right	A scuff was located on the left side of the rear of the headrest.

<b>Seat Location</b>	<b>Damage</b>	<b>Seat Location</b>	<b>Damage</b>
Row 9 left		Row 9 right	A scuff was located on the left side of the rear of the headrest. The seat deformed forward 25 cm (9.8 in).
Row 10 left		Row 10 right	
Row 11 left	There was makeup located to the center of the headrest. The seat back was dented. The dent measured 12 cm (4.7 in) in width by 6 cm (2.4 in) in height.	Row 11 right	
Row 12 left	A scuff was located in the center of the headrest.	Row 12 right	A scuff was located on the left side of headrest and the right seat arm displaced.
Row 13, left		Row 13 right	
Row 14 left		Row 14 right	A scuff was located on the seat back left of the built-in plastic bag hanger on right.
Row 15 left	The seat back was deformed forward 24 cm (9.4 in).	Row 15 right	
Row 16 left		Row 16 right	

***Right Seats***

<b>Seat Location</b>	<b>Damage</b>	<b>Seat Location</b>	<b>Damage</b>
Row 1 right			
Row 2 left	The partition rear of the guide seat was deformed forward 40 cm (15.7 in).	Row 2 right	The seat back deformed forward 8 cm (3.1 in). A skin oil transfer and scuffing was located on the headrest.
Row 3 left	The seatback deformed forward 21 cm (8.3 in).	Row 3 right	

<b>Seat Location</b>	<b>Damage</b>	<b>Seat Location</b>	<b>Damage</b>
Row 4 left	Make-up located on the right side of the headrest. The contact measured 18 cm (7 in) in width by 12 cm (4.7 in) height.	Row 4 right	
Row 5 left		Row 5 right	
Row 6 left		Row 6 right	Multiple areas of make-up were located on the headrest. The contacts measured 20 cm (7.8 in) in height by 18 cm (7 in) width.
Row 7 left	The seat back deformed forward 3 cm (1.2 in).	Row 7 right	Make-up located on the headrest; the contact measured 15 cm (5.9 in) in width by 10 cm (3.9 in) in height. There was a 6 cm (2.4 in) contact to left lower seat back.
Row 8 left		Row 8 right	A smear, possibly make-up, was located on the headrest. The smear measured 7 cm (2.8 in) in width by 9 cm (3.5 in) in height.
Row 9 left	A skin oil transfer was located on the headrest. The transfer measured 8 cm (3.1 in) in width by 9 cm (3.5 in) in height.	Row 9 right	
Row 10 left		Row 10 right	The seatback was deformed forward 8 cm (3.1 in).
Row 11 left	A foot print was located on the seat cushion. The seat back was deformed forward 13 cm (5.1in).	Row 11 right	
Row 12 left		Row 12 right	
Row 13 left		Row 13 right	
Row 14 left		Row 14 right	



**OCCUPANT DEMOGRAPHICS**

	<b>Driver</b>	<b>Occupant 02</b>	<b>Occupant 03</b>
Age/Sex:	56/Male	72/Female	49/Female
Seated Position:	Front left	Toward front	Toward front
Seat Type:	Bucket	Split-bench with separate back	Split-bench with separate back
Height:	Unknown	Unknown	150 cm (59 in)
Weight:	Unknown	Unknown	82 kg (180 lbs)
Alcohol/Drug Involvement:	None	N/A	N/A
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Steering wheel	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown
Restraint Usage:	Lap belt	N/A	N/A
	<b>Occupant 04</b>	<b>Occupant 05</b>	<b>Occupant 06</b>
Age/Sex:	58/Female	43/Female	26/Male
Seated Position:	Left side of bus, toward front	Row 3, right, window	Row 4, right, aisle
Seat Type:	Split-bench with separate back	Split-bench with separate back	Split-bench with separate back
Height:	150 cm (59 in)	170 cm (67 in)	165 cm (65 in)
Weight:	61 kg (135 lbs)	54 kg (120 lbs)	66 kg (145 lbs)
Body Posture:	Upright, facing front	Upright, facing front	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	On floor	Unknown	Unknown

	<b>Occupant 07</b>	<b>Occupant 08</b>	<b>Occupant 09</b>
Age/Sex:	25/Male	21/Male	44/Male
Seated Position:	Left side, middle of bus	Left side, aisle, middle of bus	Left side, near rear of bus, on aisle, above wheel well
Seat Type:	Split-bench with separate back	Split-bench with separate back	Split-bench with separate back
Height:	170 cm (67 in)	170 cm (67 in)	173 cm (68 in)
Weight:	68 kg (150 lbs)	73 kg (161 lbs)	68 kg (150 lbs)
Body Posture:	Upright, facing forward	Upright, reading newspaper	Leaning to one side, dozing
Hand Position:	Unknown	Holding newspaper	In lap
Foot Position:	Unknown	On floor	On floor

	<b>Occupant 10</b>	<b>Occupant 11</b>	<b>Occupant 12</b>
Age/Sex:	39/Female	60/Female	29/Female
Seated Position:	Left side of bus	Toward rear, left side	Unknown
Seat Type:	Split-bench with separate back	Split-bench with separate back	Split-bench with separate back
Height:	163 cm (64 in)	Unknown	183 (72 in)
Weight:	62 kg (137 lbs)	Unknown	73 kg (160 lbs)
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown

	<b>Occupant 13</b>	<b>Occupant 14</b>	<b>Occupant 15</b>
Age/Sex:	17/Female	51/Female	61/Male
Seated Position:	Row 8, left, aisle	Right side of bus	Row 4, left, window
Seat Type:	Split-bench with separate back	Split-bench with separate back	Split-bench with separate back
Height:	150 cm (59 in)	152 cm (60 in)	160 cm (63 in)
Weight:	50 kg (110 lbs)	54 kg (120 lbs)	64 kg (140 lbs)
Body Posture:	Facing forward, upright	Unknown	Upright
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown
	<b>Occupant 16</b>	<b>Occupant 17</b>	<b>Occupant 18</b>
Age/Sex:	25/Male	24/Female	57/Female
Seated Position:	Right side of bus	Left side of bus, towards middle, aisle seat	Unknown
Seat Type:	Split-bench with separate back	Split-bench with separate back	Split-bench with separate back
Height:	170 cm (67 in)	155 cm (61 in)	Unknown
Weight:	64 kg (140 lbs)	45 kg (100 lbs)	Unknown
Body Posture:	Facing forward, upright	Upright	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	On floor	On floor	Unknown

	<b>Occupant 19</b>	<b>Occupant 20</b>	<b>Occupant 21</b>
Age/Sex:	46/Male	49/Male	64/Female
Seated Position:	Unknown	Unknown	Unknown
Seat Type:	Split-bench with separate back	Split-bench with separate back	Split-bench with separate back
Height:	Unknown	Unknown	Unknown
Weight:	Unknown	Unknown	Unknown
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown

	<b>Occupant 22</b>	<b>Occupant 23</b>	<b>Occupant 24</b>
Age/Sex:	53/Male	45/Male	62/Female
Seated Position:	Unknown	Unknown	Unknown
Seat Type:	Split-bench with separate back	Split-bench with separate back	Split-bench with separate back
Height:	Unknown	Unknown	Unknown
Weight:	Unknown	Unknown	Unknown
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown

	<b>Occupant 25</b>	<b>Occupant 26</b>	<b>Occupant 27</b>
Age/Sex:	33/Female	25/Male	54/Female
Seated Position:	Unknown	Unknown	Unknown
Seat Type:	Split-bench with separate back	Split-bench with separate back	Split-bench with separate back
Height:	Unknown	Unknown	Unknown
Weight:	Unknown	Unknown	Unknown
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown

	<b>Occupant 28</b>	<b>Occupant 29</b>	<b>Occupant 30</b>
Age/Sex:	31/Female	19/Female	20/Male
Seated Position:	Unknown	Unknown	Unknown
Seat Type:	Split-bench with separate back	Split-bench with separate back	Split-bench with separate back
Height:	Unknown	Unknown	Unknown
Weight:	Unknown	Unknown	Unknown
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown

	<b>Occupant 31</b>	<b>Occupant 32</b>	<b>Occupant 33</b>
Age/Sex:	70/Female	59/Female	54/Male
Seated Position:	Unknown	Unknown	Unknown
Seat Type:	Split-bench with separate back	Split-bench with separate back	Split-bench with separate back
Height:	Unknown	Unknown	Unknown
Weight:	Unknown	Unknown	Unknown
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown

	<b>Occupant 34</b>	<b>Occupant 35</b>	<b>Occupant 36</b>
Age/Sex:	59/Female	46/Female	28/Female
Seated Position:	Unknown	Unknown	Unknown
Seat Type:	Split-bench with separate back	Split-bench with separate back	Split-bench with separate back
Height:	Unknown	Unknown	Unknown
Weight:	Unknown	Unknown	Unknown
Body Posture:	Unknown	Unknown	Unknown
Hand Position:	Unknown	Unknown	Unknown
Foot Position:	Unknown	Unknown	Unknown

**Occupant 37**

Age/Sex: 61/Female  
 Seated Position: Unknown  
 Seat Type: Split-bench with separate back  
 Height: Unknown  
 Weight: Unknown  
 Body Posture: Unknown  
 Hand Position: Unknown  
 Foot Position: Unknown

**Injuries and Injury Mechanisms**

Driver Injuries: Sustained non-incapacitating injuries to his face.

Occupant 02: Injuries obtained from discharge summary and radiological reports.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
C5-C6 fracture subluxation with partial quadriplegia.	640218.4,6	Seat back	Probable
Disruption of interspinous ligaments at C5-C6	630284.1,6	Seat back	Probable
Complex facial/neck laceration, left, 10-15 cm in length	390604.2,2	Unknown	Unknown
Pericardial effusion	Not codeable		
Left rib fractures (1-5) with pneumomediastinum	450232.4,2	Seat back	Probable

Occupant 03: Injuries obtained from emergency room records and radiology reports.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Comminuted nasal fracture Septal fracture	251004.2,4	Seat back	Probable

Laceration, forehead	290600.1,7	Seat back	Probable
Laceration, right side of face	290600.1,1	Seat back	Probable
Laceration, upper lip	290600.1,8	Seat back	Probable
Multiple contusions	990400.1,0	Unknown	Unknown
Cervical strain	640278.1,6	Seat back	Probable

Occupant 04: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Head lacerations	1906001.1,9	Unknown	Unknown
Laceration, right arm	7906001.1,1	Unknown	Unknown

Occupant 05: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Contusions, right shoulder and right forearm, and left hand	790402.1,3	Seat back	Probable
Contusion, right hip and right thigh, left hip and left leg	890402.1,3	Seat back	Probable
Contusion, chest	490402.1,0	Seat back	Probable
Lacerations, neck and right side of head	190600.1,1 390600.1,1	Flying glass	Possible

Occupant 06: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Bilateral lower leg lacerations	890600.1,3	Seat back	Probable
Cervical strain	640278.1,6	Seat back	Probable
Multiple contusions	990400.1,0	Unknown	Unknown



Occupant 07: Interviewee stated that he did not sustain any injuries and was not transported to any medical facility.

Occupant 08: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Multiple contusions	990400.1,0	Unknown	Unknown

Occupant 09: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Scalp contusion	190402.1,9	Seat back	Probable
Abrasion, right leg	890202.1,1	Foot rest	Probable

Occupant 10: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Fracture, left clavicle	752200.2,2	Seat back	Possible

Occupant 11: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Multiple contusions	990400.1,0	Unknown	Unknown

Occupant 12: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Neck and back strain	640278.1,6 640478.1,7	Seat back	Possible

Occupant 13: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Contusions, face (black eyes)	297402.1,1 297402.1,2	Seat back	Probable

Occupant 14: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Contusions, face	190402.1,0	Seat back	Probable

Occupant 15: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Multiple facial contusions	290402.1,0	Seat back	Probable

Occupant 16: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Multiple contusions and lacerations	990400.1,9 990600.1,9	Unknown	Unknown

Occupant 17: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Contusion to forehead	290402.1,7	Seat back	Probable

**Occupant Kinematics****Driver Kinematics**

The 56-year-old male driver was seated in an unknown posture and was not restrained by the manual lap belt. After the tire blew out, he was actively steering. During the impact with the metal guardrail, he was slightly displaced in a forward direction. At impact with the concrete barrier, he was displaced in a forward direction and probably contacted the steering wheel. He sustained non-incapacitating injuries to his face. He was transported to a Level II trauma center for treatment. It is not known if he was hospitalized.

**Occupant 02 Kinematics**

This 72-year-old female occupant was seated somewhere in the forward part of the bus and was not restrained. At impact, she was displaced in a forward direction and impacted a seat back with her face, causing a C5-C6 fracture subluxation with partial quadriplegia. She contacted the seat back with her torso, causing left side rib fractures. She was extricated from the vehicle by rescue

personnel and transported to a Level I trauma center. She arrived with a Glasgow Coma Score (GCS) of 15 and was hospitalized for 17 days.

### **Occupant 03 Kinematics**

This 49-year-old female occupant was seated somewhere in the forward part of the bus and was not restrained. At impact, she was displaced in a forward direction and impacted a seat back with her face, causing a nasal fracture, multiple facial lacerations, and a neck strain. She was extricated from the vehicle by rescue personnel and transported to a Level I trauma center where she was treated and released.

### **Occupant 04 Kinematics**

This 58-year-old female occupant was seated in the second row on the left side of the bus and was not restrained. At impact, she was displaced in a forward direction and impacted a seat back. She sustained lacerations to her head and right arm from unknown sources. She was assisted from the vehicle by another occupant and was transported to a Level II trauma center where she was treated and released. She reported that she was absent from work for 14 days.

### **Occupant 05 Kinematics**

This 43-year-old female occupant was seated in the 3<sup>rd</sup> row on the right side of the bus next to a window and was not restrained. At impact, she was displaced in a forward direction and impacted the seat back in front of her. She sustained multiple contusions to her upper and lower extremities. She exited the vehicle with the assistance of another passenger and was transported to a Level II trauma center where she was treated and released. She reported that she sustained a concussion, amnesia and had blurred vision. She also reported that she was absent from work for 20 days.

### **Occupant 06 Kinematics**

This 26-year-old male occupant was seated in the 4<sup>th</sup> row on the right side of the bus next to the aisle and was not restrained. At impact, he was displaced forward and impacted the seat back in front of him. He sustained bilateral lower leg lacerations, probably from the foot rests at the bottom of the seat. He also sustained an indirect contact neck strain from contacting the seat back. He exited the vehicle under his own power and was transported to a local hospital where he was treated and released. He reported that he lost 2 days of work due to the crash.

### **Occupant 07 Kinematics**

This 25-year-old male occupant was seated on the left side of the bus near the middle and was not restrained. At impact, he was displaced forward and probably contacted the seat back in front of him. He stated that he did not sustain any injuries and was not transported to any medical facility. He was able to exit the vehicle under his own power.

**Occupant 08 Kinematics**

This 21-year-old male occupant was seated on the left side of the bus, in a aisle seat, near the middle of the bus. He was not restrained. At impact, he was displaced forward and probably contacted the seat back in front of him. He sustained multiple non-specific contusions. He exited the vehicle under his own power and was transported to a local hospital where he was treated and released. He reported that he lost 1-2 days of work due to the crash.

**Occupant 09 Kinematics**

This 44-year-old male occupant was seated on the left side of the bus in an aisle seat near the rear wheel well. He was not restrained. He was leaning to the left and was dozing prior to the crash. At impact, he was displaced in a forward direction and contacted the seat back with his head and the foot rest with his right leg. He exited the vehicle under his own power through a side window and was not treated at a medical facility.

**Occupant 10 Kinematics**

This 39-year-old female occupant was seated on the left side of the bus and was not restrained. At impact, she was displaced in a forward direction and impacted the seat back in front of her with her left shoulder, causing a fractured left clavicle. She exited the vehicle with the assistance other parties on the bus. She was transported to a local hospital where she was treated and released.

**Occupant 11 Kinematics**

This 60-year-old female occupant was seat on the left side of the bus near the rear and was not restrained. At impact, she was displaced forward and probably contacted the seat back in front of her. She sustained multiple non-specific contusions. It is not known how she exited the vehicle. She was transported to a local hospital where she was treated and released.

**Occupant 12 Kinematics**

This 29-year-old female occupant was seated in an unknown location and was not restrained. At impact, she was displaced forward and probably contacted the seat back in front of her. She sustain neck and back strains. It is not know how she exited the vehicle. She was transported to a local hospital where she was treated and released.

**Occupant 13 Kinematics**

This 17-year-old female occupant was seated in the 8<sup>th</sup> row, left side, in an aisle seat. She was unrestrained. At impact, she was displaced forward and impacted the seat back with her face. She sustained bilateral eyelid/soft tissue contusions. She exited the vehicle with assistance from other parties on the bus, and was transported to a local hospital where she was treated and released.

**Occupant 14 Kinematics**

This 51-year-old female was seated in the right side of the bus and was unrestrained. At impact, she was displaced forward and impacted the seat back with her face, causing multiple facial contusions. It is not known how she exited the bus. She was transported to a local hospital where she was treated and admitted for one day.

**Occupant 15 Kinematics**

This 61-year-old male occupant was seated in the 4<sup>th</sup> row on the left side of the bus next to a window and was not restrained. At impact, he was displaced in a forward direction and impacted a seat back with face, causing multiple facial contusions. It is not known how he exited the vehicle. He was transported to a Level I trauma center where he was treated and released.

**Occupant 16 Kinematics**

This 25-year-old male occupant was seated on the right side of the bus and was not restrained. At impact, he was displaced forward and probably contacted the seat back in front of him. He reported that he sustained multiple lacerations and contusions and was able to exit the vehicle under his own power. He was transported to a local hospital but it was not known if he was admitted.

**Occupant 17 Kinematics**

This 24-year-old female occupant was seated on the left side of the bus in the middle in an aisle seat. At impact, she was displaced forward and contacted the seat in front of her with her head, causing a minor contusion. She was able to exit the vehicle under her own power. She contacted a friend by cell phone who took her to a clinic where she was treated and released.

**Occupant 18-37 Kinematics**

The remaining occupants underwent a similar displacement pattern as the previous occupants. They were in similar seat types, in a forward-facing orientation, and were unrestrained. They would have been displaced forward and probably contacted the seats in front of them with varying levels of injury severities.

### Attachment 1. Scene Diagram

