

**CRASH RESEARCH & ANALYSIS, INC.**

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**ON-SITE AMBULANCE CRASH INVESTIGATION**

**SCI CASE NO: CR13004**

**VEHICLE: 1999 FORD E-350 CHASSIS**

**AMBULANCE BODY: AMERICAN EMERGENCY VEHICLES TYPE II**

**LOCATION: WEST VIRGINIA**

**CRASH DATE: JANUARY 2013**

Contract No. DTNH22-12-C-00269

Prepared for:

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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 are 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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<i>16. Abstract</i> This on-site investigation focused on the offset front-to-rear crash of a 1999 Ford E-350/American Emergency Vehicle (AEV) Type II ambulance and the injury source(s) for the fatally injured 26-year-old male Emergency Medical Technician (EMT) occupying the front right passenger seat. The front plane of the ambulance struck the back plane of a loaded 2006 Freightliner tractor/flatbed semi-trailer. The ambulance was returning to its home base after transporting a 13-month-old patient to a pediatric hospital located in a northern region of the state. The patient compartment was unoccupied. At the time of the crash, the ambulance was approximately one hour into its return trip, which had an estimated total length of three hours. The ambulance was traveling southbound on an interstate highway during the dark, early morning hours. The driver fell asleep precipitating the impact. The force of the impact completely separated the right side structures of the ambulance from the chassis.			
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**LOCATION: WEST VIRGINIA**  
**CRASH DATE: JANUARY 2013**

***BACKGROUND***

This on-site investigation focused on the offset front-to-rear crash of a 1999 Ford E-350/American Emergency Vehicle (AEV) Type II ambulance (**Figure 1**) and the injury source(s) for the fatally injured 26-year-old male Emergency Medical Technician (EMT) occupying the front right passenger seat. The front plane of the ambulance struck the back plane of a loaded 2006 Freightliner tractor/flatbed semi-trailer.

The crash was identified by the National Highway Traffic Safety Administration's (NHTSA) Office of Emergency Medical Services (EMS) and further research of the crash was requested through the NHTSA's Crash Investigation Division (CID). In-turn, CID forwarded the notification to the Special Crash Investigations (SCI) team at Crash Research & Analysis, Inc. on January 21, 2013. The SCI team contacted the investigating police agency and the ambulance company to begin the process of establishing cooperation. Police cooperation was obtained on January 25, 2013, and the case was assigned for on-site investigation. Cooperation with the ambulance company was established on January 26, 2013. The ambulance company had taken possession of the ambulance and stored the vehicle at a maintenance facility located near its base of operations. The on-site investigation was conducted January 29 and 30, 2013, and involved the detailed inspection of the ambulance and crash site. Interviews were conducted with the police investigator and the ambulance company Operations Director. The 1999 Ford E-350 was not supported by the Bosch Crash Data Retrieval (CDR) tool. Therefore, no data was obtained. The ambulance was equipped with a Drive Cam™ video monitor and Fleetmatics™ GPS tracking. The output data from those devices were reviewed and their contents were incorporated in this report



The ambulance was returning to its home base after transporting a 13-month-old patient to a pediatric hospital located in a northern region of the state. The ambulance was occupied by a restrained 26-year-old male paramedic driver and the unrestrained 26-year-old male EMT front right passenger. The patient compartment was unoccupied. At the time of the crash, the ambulance was approximately one hour into its return trip, which had an estimated one way-length of three hours. The ambulance was traveling southbound on an interstate highway. It was dark at the time of the early morning crash. The driver fell asleep and the front plane of the ambulance impacted the back plane/left aspect of the flatbed semi-trailer. The force of the impact completely separated the right side structures of the ambulance from the chassis. The right fender, A-pillar, and right side panels deformed and folded rearward. The ambulance came to rest engaged with the left plane of the trailer (**Figure 2**). The front right passenger sustained fatal injuries in the crash. The ambulance driver sustained non-incapacitating (B) injuries. The two occupants of the tractor (driver and passenger) were not injured. The Freightliner was released at the conclusion of the on-scene police investigation and continued on its assigned route. The tractor/flatbed trailer was not available for inspection.



**Figure 2: On-scene image of the vehicles at final rest. (Image supplied by the police investigator.)**

### ***AMBULANCE COMPANY***

The Ford E-350 Type II ambulance was owned by a large EMS. The company operated a fleet of approximately 130 vehicles and served a nine county region. The ambulance service provided emergency response in four counties, back-up emergency response in five counties, and additionally provided private and inter-hospital medical transportation as needed. The company logged over 4.8 million km (3 million miles) annually with volume of approximately 110,000 calls. The 26-year-old paramedic driver had worked for the company for several years. The 26-year-old EMT had been employed by the company for 13 months.

The paramedic and EMT typically worked a 24-hour shift Monday, Wednesday, and Friday starting at 0730 hours. During the week of the crash, this crew had also worked an extra overtime shift on Sunday. At the time of the crash, these individuals had been on-call for approximately 44 hours during which 16 hours were logged as active on-duty time. During the balance of those hours, the crew was stationed at the home base and was allowed to sleep and/or go about normal activities.

## CRASH SUMMARY

### *Crash Site*

The two-vehicle crash occurred during the nighttime hours of January 2013. The police-reported environmental conditions were cloudy, dark and wet. The National Weather Service reported temperature was one degree C (34 degrees F) with calm winds and 100% relative humidity. The crash occurred on the southbound right lane of a two-lane divided interstate highway in a rural setting (**Figure 3**). The southbound roadway consisted of two 3.75 m (12.3 ft) lanes divided by a broken center line with a 3.65 m (12.0 ft) wide breakdown lane. The west shoulder was asphalt and measured 4.5 m (14.8 ft) wide to a W-beam guardrail. There was a positive 5% grade and a moderate left curve throughout the crash site. The radius of the curve measured 538 m (1,765 ft) with a 3% super-elevation. The interstate speed limit was 113 km/h (70 mph).



**Figure 3:** Look back along the southbound lanes of the interstate at the crash site.

In this region of West Virginia, the topography is mountainous and the interstate highway is winding with long grades (positive and negative). Leading into the area of the crash, there was a positive 5% grade for approximately 2.4 km (1.5 miles). Over that distance there was a moderate radius right curve and then a straight section approximately 0.8 km (0.5 miles) long that led into the left curve described above. Loaded heavy trucks labored, at a reduced speed due to the length of the grade, to reach the mountain crest, based on the SCI investigator's observations during the scene inspection. The hillcrest was located approximately 1.2 km (0.75 mile) south of the crash site.

### *Pre-Crash*

The 2006 Freightliner tractor/flatbed semi-trailer was traveling southbound in the right lane driven by a 41-year-old male. A 42-year-old male passenger was asleep in the tractor's sleeper berth. The flatbed trailer was loaded with bundles of various diameter aluminum tubing sections. The net weight of the aluminum load was 21,351 kg (47,070 lb). The heavily loaded truck was proceeding up the long grade at an undetermined slow speed.

The Operations Director of the ambulance company reported that the EMT drove the outbound leg of the trip while the paramedic attended to the 13-month-old patient in the back of the ambulance. The trip log for this run reported that the ambulance crew left their home base at 2315 hours. They picked up a patient at an outlying hospital and departed for the pediatric center at 0015 hours. The log indicated that they arrived at their destination 2 hours and 55 minutes

later. The crew called in, stopped at a fast food drive-through and began the return trip at 0345 hours. Due to the early morning hours and the extended shift hours that these individuals had been working, the paramedic was going to drive half of the way back while the EMT slept. Their intention was to switch places and the EMT would drive the rest of the way to the home base. The paramedic driver reported to the police investigator that he had slept 1.5 hours during the preceding 24-hour time block.

As the ambulance ascended the grade, the paramedic driver of the ambulance was operating the vehicle southbound. The EMT front right passenger was resting. It was not clear if he was actually asleep. The crew was approximately one hour into the three hour return leg. The ambulance was equipped with Fleetmatics™ GPS tracking for fleet management. This device transmitted the vehicle's speed and location to the company's headquarters every two minutes. Over the length of the return trip, the average highway speed of the ambulance was 109 km/h (68 mph).

Based on a review of the Drive Cam™ video, the ambulance drifted from the right lane and straddled the centerline approximately 8.5 seconds prior to the crash. **Figure 4** is frame capture from the Drive Cam™ 7.0 seconds prior to the impact. The vehicle returned to the right lane approximately 4.5 seconds prior to the impact and continued to negotiate the left curve. The tractor/loaded flatbed trailer was visible throughout the video sequence and the distance between the vehicles was closing. The slowly-moving tractor/trailer's taillights were illuminated. **Figure 5** is a frame capture 0.75 seconds prior to impact. As the ambulance approached the back plane of the flatbed trailer, the paramedic driver recognized the slower moving vehicle and initiated a left avoidance maneuver (counterclockwise steering) approximately 0.5 seconds prior to the crash. The late steering maneuver by the ambulance driver resulted in a narrow overlap of the structure of the vehicles. The Fleetmatics™-reported speed of the ambulance was 106 km/h (66 mph).



Figure 4: Drive Cam™ video capture from the ambulance 7.0 seconds prior to impact.



Figure 5: Drive Cam™ video capture 0.75 seconds prior to impact.

### *Crash*

The front right corner of the ambulance impacted the back left corner of the loaded flatbed trailer. The direct contact damage to the ambulance's front bumper was located to the right of the frame rail. The relatively soft structures of the front profile of the ambulance engaged the



rigid structure of the trailer's back profile. The frontal air bags in the ambulance deployed and the front seat safety belt pretensioners actuated. The left aspect of the trailer's rear impact guard deflected forward. As the right plane of the ambulance engaged against the trailer's load, the side structure completely separated. The right interior components of the patient compartment fractured and were deposited onto the roadway. The side structure of the ambulance deformed, folding rearward, hinging at the right D-pillar. The ambulance remained in contact with the trailer as it decelerated. The Freightliner driver applied the brakes and came to a controlled stop in the right lane of the interstate. At final rest the ambulance remained engaged against the left side of the flatbed trailer and its load (**Figure 6**). A Crash Diagram is included at the end of this technical report on Page 15.



**Figure 6: Front view of the ambulance engaged against the flat-bed trailer at final rest. (Image supplied by the police investigator.)**

### ***Post-Crash***

The police, firefighters and EMS personnel responded to the scene of the crash. The paramedic driver of the ambulance exited the vehicle under his own power. Reportedly, he crawled under the trailer and into the patient compartment of the ambulance to assist the seriously injured EMT. Upon his arrival, the police investigator also entered the patient compartment to render aid to the EMT.

The EMT was lying rearward, partially on the front right seat. His lower extremities/feet were under the intruded instrument panel. His upper body was lying diagonally across the reclined seat toward the patient compartment pass-through. A pooling of blood adjacent to the rear-facing captain's chair in the patient compartment identified the position of his head. He sustained police-reported severe blunt trauma to the face and chest and was unresponsive. The paramedic and police investigator attempted life-support as rescue personnel continued to arrive.

The rear doors of the ambulance were removed by rescue personnel to gain access to the patient compartment. The EMT was first placed on the ambulance cot, removed from the crashed ambulance and then transferred to the cot of an awaiting ambulance. All life supportive measures were unsuccessful and the EMT was pronounced deceased 17 minutes after arrival at the hospital. The paramedic driver sustained safety belt-related chest contusions. The Freightliner driver and the sleeping passenger in the tractor's sleeper berth were not injured.

## 1999 FORD E-350 CHASSIS/AEV TYPE II AMBULANCE

### Description

The 1999 Ford E-350 Type II ambulance (Figure 7) was owned by a private ambulance company that had a fleet of approximately 130 vehicles. This particular ambulance was a spare vehicle and was used for occasional service.

The Ford E-350 chassis was identified by the Vehicle Identification Number (VIN): 1FDSS34F4XHxxxxxx and was manufactured as an incomplete vehicle in June 1999. The odometer reading was 907,083 km (563,635 miles). The Super Duty extended van was built on a 351 cm (138 in) wheelbase and was equipped with the Type II ambulance prep package. The rear-wheel drive vehicle had a Gross Vehicle Weight Rating (GVWR) of 4,264 kg (9,400 lb) with a front axle and rear axle rating of 2,087 kg (4,600 lb) and 2,760 kg (6,084 lb), respectively. The powertrain consisted of a 7.3-liter, V-8 engine linked to a 4-speed automatic transmission. The manufacturer's recommended tire size was LT245/75R16 front and rear, with cold tire pressures of 379 kPa (55 PSI) front and 552 kPa (80 PSI) rear. All four tires were Nexen Radian ATII of the recommended size. Specific measured tire data was as follows:



Figure 7: Overhead view of the ambulance.

Position	Measured Pressure	Measured Tread Depth	Restriction	Damage
LF	434 kPa (63 PSI)	7 mm (9/32 in)	No	No
LR	427 kPa (62 PSI)	6 mm (7/32 in)	No	No
RR	441 kPa (64 PSI)	4 mm (5/32 in)	No	No
RF	Tire flat	7 mm (9/32 in)	No	Sidewall cut, tire debaded

The front interior of the Ford was equipped with box-mounted bucket seats with integral head restraints. Safety features included 3-point lap and shoulder safety belts with buckle pretensioners for the front occupants. The driver and front right passenger positions were equipped with frontal air bags.

### Patient Compartment Description

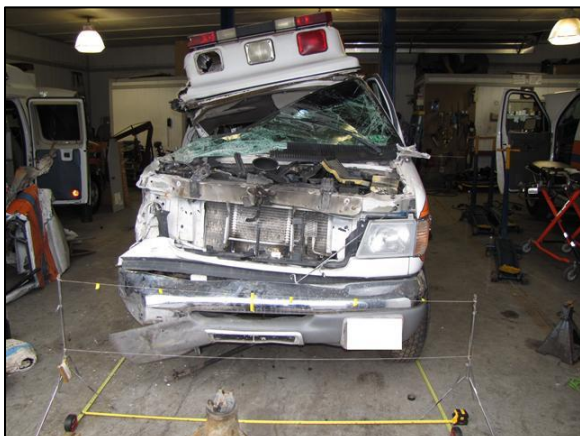
The patient compartment of the ambulance, Model XKF23, was manufactured by American Emergency Vehicles (AEV) of Jefferson, NC in September 1999. The patient compartment consisted of the typical Type II interior layout with a raised fiberglass roof. The layout included: double-rear entry doors for stretcher loading, a three-passenger bench seat along the right side, a rear-facing Captain's seat against the bulkhead immediately forward of the stretcher, double

right side entry doors, multiple cabinets for storage and an open pass-through to the occupant compartment of the van.

### ***Exterior Damage***

The front plane of the Ford (**Figure 8**) sustained corner impact damage and its right plane engaged the back plane of the trailer (**Figure 9**) during the impact. The direct contact to the front plane began 60 cm (23.5 in) right of center and extended to the right corner of the front bumper. The length of the direct contact measured 24 cm (9.5 in). The impact damage was located to the right of the right frame rail. There was no noted deformation of the vehicle's frame. The residual crush measured along the front bumper had the following profile: C1 = 0, C2 = 0, C3 = 0, C4 = 0, C5 = 0, C6 = 17 cm (6.7 in). The residual crush at the right corner of the upper radiator support measured 33 cm (13.0 in).

As the higher speed ambulance engaged the trailer, the sheet metal of the right plane sheared (tore) along the entire length of the vehicle. Examination of the exposed vehicle structure found that the spot welds from assembly were intact and that the sheet metal surrounding the welds tore. The sheet metal tore away due to overload. The right fender separated from the inner structure. The front right brake rotor fractured from impact with the trailer and the wheel assembly separated. The right wheel base was reduced 17 cm (6.8 in). The A-pillar hinge and right front door separated as a unit. The B- and C-pillars separated at the roof side rail and sill. The separated right wall folded/hinged rearward at the D-pillar and extended rearward beyond the vehicle at final rest. The fiberglass raised roof of the ambulance was separated from the roof side rails and the end-plane headers around its entire perimeter. The Collision Deformation Classification (CDC) assigned to this damage pattern was 12FRAE9. Analysis of this crash by the WinSMASH program was not possible. Heavy truck collisions and corner impact configurations (outside the vehicle's frame/stiffness) were beyond the scope of the program.



**Figure 8: Front view of the ambulance.**



**Figure 9: Right side view of the ambulance.**

### ***Event Data Recorder***

The Ford was not equipped with an Event Data Recorder. Therefore, no data was imaged.

### ***Interior Damage***

The interior damage of the Ford's forward compartment consisted of moderate intrusion and component damage that was directly related to the exterior force of the crash. The longitudinal intrusion of the right corner of the instrument panel measured 23 cm (9 in). The separation of the right A-pillar allowed the supported right roof area to intrude vertically. The front right roof, upper A-pillar and right roof side rail intruded together as an assembly. This intrusion measured 19 cm (7.5 in).

The box-mounted driver seat was adjusted to a mid-to-rear track position that measured 3 cm (1 in) forward of full-rear. The total seat track travel measured 15 cm (6 in). The seat back angle measured 10 degrees. The horizontal distance from the seat back to the driver air bag module measured 51 cm (20 in). There was no steering wheel rim deformation or shear capsule displacement. The rigid trim panel of the driver knee bolster panel was missing. There was no deformation to the steel backer of the bolster.

The box-mounted front right passenger seat track was jammed. Based on the observations of the SCI inspection, the seat was adjusted in a mid-to-rear track position similar to the driver seat. At the time of the SCI inspection, the seat back was reclined to a measured angle of 55 degrees (**Figure 10**). The seat's recline mechanism was inspected and it was determined to be operational. The seat back moved freely throughout its range of motion and the ratchet-mechanism of adjustment locked the seat back in various positions. There was evidence of direct contact on the exposed right surface of the seat, trim panel and recline mechanism to the sidewall of the semi-trailer's rear tire, highlighted by the red ellipse in **Figure 10**. Scuffing abrasions and melted rubber fragments were observed on the right surface of the seat cushion and on the trim panel, respectively. It was determined that during the vehicle-to-vehicle interaction of the crash, the recline mechanism was contacted by the sidewall of the trailer's tire, thus releasing the seat back and allowing the seat back to fully recline. The height of the damage was consistent with the height of the trailer tire. Also, the on-scene police images indicted that at final rest the trailer tire was adjacent to the passenger seat. The seat back was not forced rearward into the reclined position by occupant loading.



**Figure 10: Right view depicting reclined position of the front right seat and the intrusion and deformation at that location. Note, the scuffing and abrasions to the seat cushion and trim highlighted by the red ellipse.**



### ***Manual Restraint Systems***

The manual restraints for the driver and front right passenger positions consisted of 3-point lap and shoulder safety belts with buckle pretensioners. The front belt systems consisted of continuous loop webbing, light weight locking latch plates, and adjustable D-rings. The driver's restraint was equipped with an Emergency Locking Retractor (ELR). The front right restraint was equipped with a switchable ELR/Automatic Locking Retractor (ELR/ALR). The driver D-ring was in the full-down position. The separated front right D-ring was missing.

Examination of the driver's restraint revealed extensive historical use due to the age of the vehicle; the edges of the webbing were frayed from repeated use. The plastic surface of the latch plate had a minor abrasion due to the friction caused by occupant loading at the time of the crash. The D-ring did not display any physical evidence. The buckle pretensioner was actuated. The driver was restrained by the safety belt at the time of the crash based on observations during the SCI inspection.

The manual restraint for the front right seat position was not found. It had separated from the vehicle during the crash. Examination of the buckle and stalk determined that it was not damaged. If the restraint had been buckled into the receiver at the time of the crash, the buckle and stalk would have been damaged during the separation and displacement of the B-pillar. Further, examination determined that the buckle pretensioner had actuated. The cable crimp, attached to the pretensioner piston, was exposed approximately 19 mm (0.75 in) from the end of the piston barrel. The exposed condition of the crimp indicated to the SCI investigator that the pretensioner had actuated without the latch plate buckled in the receiver. The cable crimp of the driver's pretensioner rested approximately 13 mm (0.5 in) inside the end of the barrel for comparison. The front right passenger was unrestrained at the time of the crash based on the vehicle inspection.

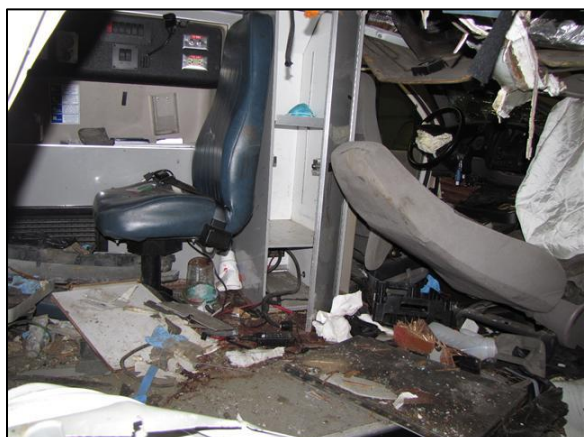
### ***Supplemental Restraint Systems***

The ambulance was equipped with driver and front right passenger air bags that deployed as a result of the impact. The driver air bag module was mounted in the center of the steering wheel rim. The air bag measured 64 cm (25 in) in diameter and was tethered by two straps. It was vented by two ports in the 11/1 o'clock positions of the forward side of the air bag. There was no occupant contact evidence visible on the face of the air bag.

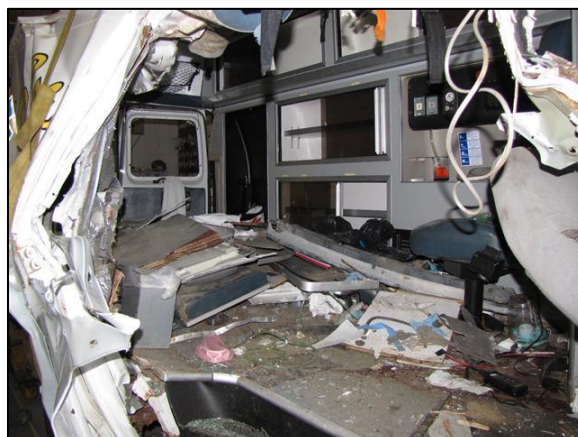
The front right passenger air bag was a mid-mount design located in the right aspect of the instrument panel. The rectangular cover flap measured 38 cm x 23 cm (15 in x 9 in), width by height, and followed the convex shape of the instrument panel. There was no occupant contact to the cover flap. The face of the air bag measured 46 cm x 61 cm (18 in x 24 in), width by height. It was vented by two ports on the side panels. The air bag was not tethered. There was no observed occupant contact evidence on the air bag.

### ***Patient Compartment Damage***

The patient compartment was not occupied at the time of the crash. The plywood cabinetry and interior components of the right side of the vehicle were directly involved in the overlapping crash. The vertical cabinet located immediately behind the front right passenger seat fractured at floor level and was displaced (**Figure 11**). The three-passenger bench seat was displaced onto the roadway. The Ferno cot remained secured by the floor-mounted rail clamp and was not damaged. **Figure 12** is a rearward oblique interior view depicting the patient compartment damage taken during the SCI inspection.



**Figure 11:** Right interior view depicting the fractured/separated cabinet immediately behind the front right seat.



**Figure 12:** Right oblique view depicting the patient compartment damage.

### ***Exemplar Patient Compartment***

For reference, the interior of a similar AEV Type II ambulance was inspected (**Figure 13**). The cabinet located immediately behind the front right seat measured 61 cm x 38 cm x 127 cm (24 in x 15 in x 50 in), width by depth by height. The cabinet was manufactured of 19 mm (3/4 in) plywood. The front right seat was adjusted to a position 3 cm (1 in) forward of full-rear consistent with the front right seat of the involved ambulance. In this mid-to-rear track adjustment, the position of the cabinet limited the recline angle of the seat back to 12 degrees aft of vertical.



**Figure 13:** Rear interior view of an exemplar AEV Type II patient compartment.

**1999 FORD E-350/TYPE II AMBULANCE OCCUPANTS*****Paramedic Driver Demographics***

Age / Sex: 26 years / Male  
 Height: 183 cm (72 in)  
 Weight: 109 kg (240 lb)  
 Eyewear: None  
 Seat Type: Box-mounted bucket seat  
 Seat Track Position: Mid-to-rear  
 Manual Restraint Usage: 3-point lap and shoulder safety belt  
 Usage Source: SCI inspection  
 Air Bags: Deployed frontal  
 Alcohol/Drug Involvement: None  
 Egress from Vehicle: Exited under own power  
 Transport from Scene: Ambulance to a hospital  
 Medical Treatment: Admitted, length of stay unknown

***Driver Injuries***

<b>Injury No.</b>	<b>Injury</b>	<b>AIS 2005/08</b>	<b>Injury Source</b>	<b>Confidence Level</b>
1	Safety belt-related chest contusions, NFS	410402.1,4	Safety belt	Certain

*Source: Interview with the ambulance company Operations Director.*

***Driver Kinematics***

The ambulance driver was seated in a mid-to-rear track position at the time of the crash and was restrained. The driver was tired and drowsy. Based on the observations of the Drive Cam™ video, during the 10-second time period leading up to the crash the ambulance drifted from the right lane, across the centerline and then returned to the right lane. The ambulance was traveling at a reported speed of 106 km/h (66 mph) and quickly closed on the slower moving tractor/semi-trailer. The driver realized the imminent impact and steered to the left (CCW steering wheel rotation) immediately prior to the crash.

At impact, the safety belt retractor locked, the pretensioner actuated and the frontal air bags deployed. The driver responded to the 12 o'clock direction of the impact force by initiating a forward and slightly right trajectory. The driver contacted the locked belt system and deployed driver air bag with his chest and head. The ambulance engaged the loaded semi-trailer along its entire right side and decelerated. The prolonged engagement resulted in a crash pulse that had a long duration. The driver remained in contact with the vehicle's safety systems and rode down the force of the crash.

The driver sustained chest contusions from his safety belt loading. He was able to exit the ambulance under his own power and rendered aid to the injured front right passenger. He was

transported and admitted to a hospital for an unknown period of time due to the traumatic experience of the crash and its outcome.

### ***EMT Front Right Passenger Demographics***

Age / Sex: 26 years / Male  
 Height: 175 cm (69 in)  
 Weight: 79 kg (175 lb)  
 Eyewear: None  
 Seat Type: Box-mounted bucket seat  
 Seat Track Position: Mid-to-rear  
 Manual Restraint Usage: None  
 Usage Source: SCI inspection  
 Air Bags: Deployed frontal  
 Alcohol/Drug Involvement: None  
 Egress from Vehicle: Removed due to perceived serious injury  
 Transport from Scene: Ambulance to a hospital  
 Medical Treatment: None, dead upon arrival

### ***EMT Injuries***

<b>Injury No.</b>	<b>Injury</b>	<b>AIS 2005/08</b>	<b>Injury Source</b>	<b>Confidence Level</b>
1	Crush injury of the right zygoma	251814.2,1	Other vehicle	Certain
2	Crush injury of right inferior orbit	251213.2,1	Other vehicle	Certain
3	Upper maxilla fracture, NFS	250800.2,9	Other vehicle	Certain
4	Nasal fracture, NFS	251000.1,4	Other vehicle	Certain

*Source: Hospital Emergency Room Records. Considering his immediate death, the injuries identified in the ER records under-reported the severity of the passenger's trauma. The Autopsy Record was not available.*

### ***EMT Kinematics***

The 26-year-old EMT front right passenger was seated in a mid-to-rear seat track position. The seat back was slightly reclined (estimated at 10-12 degrees) based on exemplar measurements. He was resting and possibly asleep at the time of the crash. He was not restrained by the manual safety belt system.

Immediately prior to the crash, the driver steered to the left (CCW rotation of the steering wheel) in an attempted avoidance maneuver. The EMT passenger responded to the sudden steering maneuver with a right lateral displacement. His torso contacted the right door panel and his head likely contacted the window glazing.

At impact, the frontal air bags deployed. The unrestrained passenger responded with a forward trajectory along the door panel and loaded the inflated air bag with his head and chest. During his forward response and air bag loading, the instrument panel intruded and the load of the semi-



trailer entered his occupant space. The passenger's face/head/chest impacted the back plane of the trailer's load resulting in the identified injuries.

As the right side of the ambulance engaged along the left side of the semi-trailer, the front right passenger seat back reclined. The EMT was displaced rearward by his engagement with the loaded trailer and came to rest lying diagonally across the front right passenger seat. His lower extremities and feet became captured between the intruded instrument panel and the seat cushion. The EMT's head was positioned in the pass-through to the patient compartment, adjacent to the rear-facing Captain's chair evidenced by a pooling of blood.

The driver exited the ambulance, entered the patient compartment and began to apply Advanced Life Supportive (ALS) measures to the EMT. The responding police investigator also entered the patient compartment and rendered aid. The emergency personnel from the county ambulance service responded to the crash scene eight minutes after the dispatch time. At assessment, the passenger was unresponsive with a Glasgow Coma Score (GCS) of 3. Blood was noted to be hemorrhaging from the nose and from both ears. The passenger's feet were entrapped by the intruded instrument panel with a reported extrication time was 15 minutes.

The passenger was removed from the crashed ambulance and placed in the responding ambulance for transport to the hospital. He was in traumatic arrest with circulatory collapse at that time. ALS procedures continued throughout this time; however, he remained pulseless and was without breath sounds.

The transporting ambulance departed the crash site 30 minutes after arrival on-scene and arrived at the hospital eight minutes later. Efforts to revive the passenger continued in the hospital emergency room, but were unsuccessful. He was pronounced deceased 17 minutes after arrival at the hospital. The final assessment by the treating physician was: "Significant head trauma with probable herniation and cardiac arrest with inability to resuscitate."

## **2006 FREIGHTLINER TRACTOR/FLATBED SEMI-TRAILER**

### ***Description***

The 2006 Freightliner Columbia tractor was identified by the VIN: 1FUJA6CV86Lxxxxxx. The Class-8 tractor was configured with a 6x4 drivetrain and had a maximum Gross Vehicle Weight Rating (GVWR) of 25,855 kg (57,000 lb). The tractor was hauling a loaded 1997 Wabash/Wanc flatbed semi-trailer at the time of the crash. The flatbed trailer was loaded with 31 bundles of various diameter aluminum tubing that weighed 21,251 kg (47,070 lb). **Figure 14** is an on-scene police image of the vehicle. At the conclusion of the police investigation and Freightliner was released and the vehicle continued its route of travel.

***Freightliner Occupants***

The restrained 41-year-old male driver of the Freightliner exited the vehicle under his own power and was not injured in the crash. A 42-year-old unrestrained male passenger was sleeping in the berth at the time of the crash and was not injured.



**Figure 14: Front left oblique view of the Freightliner at the crash site. (Image supplied by the police investigator.)**

**CRASH DIAGRAM**